State of California
The Resources Agency
Department of Water Resources

EXHIBIT B
PROJECT OPERATION
AND RESOURCE UTILIZATION

Oroville Facilities
FERC Project No. 2100

January 2005

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EXHIBIT B
PROJECT OPERATION AND RESOURCE UTILIZATION

The following information is provided in compliance with the requirements of CFR 18, Chapter 1, Subchapter B, §4.51(c).

1.0 GENERAL PROJECT DESCRIPTION

1.1 OVERVIEW

The Oroville Facilities (FERC Project No. 2100) were developed as part of the State Water Project (SWP), a water storage and delivery system of reservoirs, aqueducts, power plants, and pumping plants. The main purpose of the SWP is to store and distribute water to supplement the needs of urban and agricultural water users in northern California, the San Francisco Bay area, the San Joaquin Valley, and southern California. The Oroville Facilities are also operated for flood management, power generation, water quality improvement in the Delta, and recreation and fish and wildlife enhancement.

FERC Project No. 2100 encompasses 41,100 acres and includes Oroville Dam and Reservoir, three power plants (Hyatt Pumping-Generating Plant, Thermalito Diversion Dam Powerplant, and Thermalito Pumping-Generating Plant), Thermalito Diversion Dam, the Feather River Fish Hatchery and Fish Barrier Dam, Thermalito Power Canal, Oroville Wildlife Area (OWA), Thermalito Forebay and Forebay Dam, Thermalito Afterbay and Afterbay Dam, and transmission lines, as well as a number of recreational facilities. An overview of these facilities is provided on Figure B.1.1-1. The Oroville Dam, along with two small saddle dams, impounds Lake Oroville, a 3.5 million acre-feet (maf) capacity storage reservoir with a surface area of 15,810 acres at its normal maximum operating level.

1.2 EXISTING POWER FACILITIES

The hydroelectric facilities have a combined license generating capacity of approximately 762 megawatts (MW). The Hyatt Pumping-Generating Plant is the largest of the three power plants with a capacity of 645 MW. Water from the six-unit underground power plant (three conventional generating and three pumping-generating units) is discharged through two tunnels into the Feather River just downstream of Oroville Dam. The plant has a generating and pumping flow capacity of 16,950 cfs and 5,610 cfs, respectively. Other generation facilities include the 3 MW Thermalito Diversion Dam Powerplant and the 114 MW Thermalito Pumping-Generating Plant.

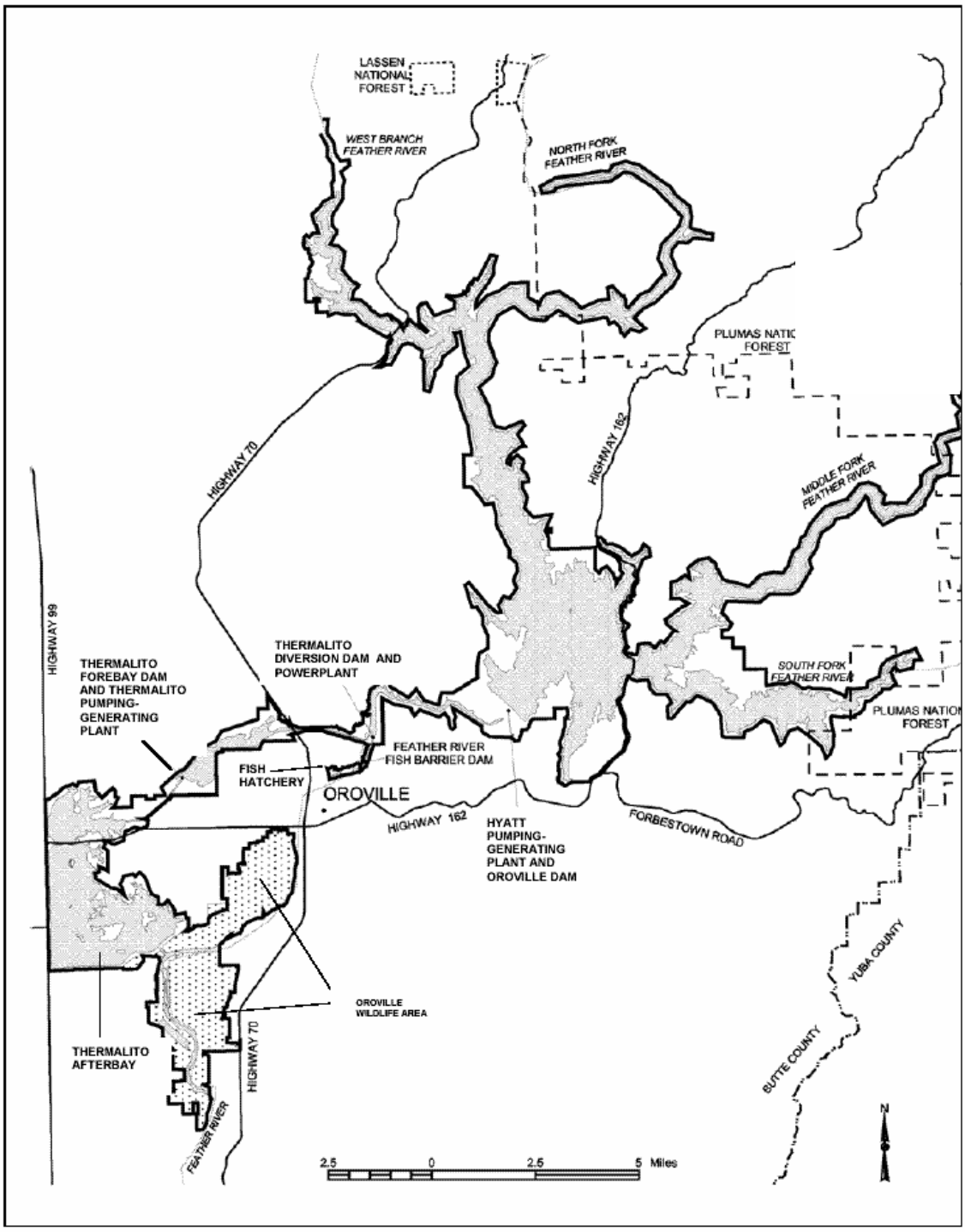


Figure B.1.1-1. Oroville Facilities features location map.

Thermalito Diversion Dam, four miles downstream of the Oroville Dam creates a tail water pool for the Hyatt Pumping-Generating Plant and is used to divert water to the Thermalito Power Canal. The Thermalito Diversion Dam Powerplant is a 3 MW power plant located on the left abutment of the Diversion Dam. The power plant releases a maximum of 615 cubic feet per second (cfs) of water into the river.

The Thermalito Power Canal is a 10,000-foot-long channel designed to convey generating flows of 16,900 cfs to the Thermalito Forebay and pump-back flows to the Hyatt Pumping-Generating Plant. The Thermalito Forebay is an off-stream regulating reservoir for the Thermalito Pumping-Generating Plant.

The Thermalito Pumping-Generating Plant is designed to operate in tandem with the Hyatt Pumping-Generating Plant and has generating and pump-back flow capacities of 17,400 cfs and 9,120 cfs, respectively. When in generating mode, the Thermalito Pumping-Generating Plant discharges into the Thermalito Afterbay, which is contained by a 42,000-foot-long earth-fill dam. Thermalito Afterbay is used to release water into the Feather River downstream of the Oroville Facilities, helps regulate the power system, provides storage for pump-back operations, and provides recreational opportunities. Several local irrigation districts receive water from Thermalito Afterbay**.**

1.3 EXISTING ENVIRONMENTAL AND RECREATION COMMITMENTS

The Feather River Fish Barrier Dam is downstream of the Thermalito Diversion Dam and immediately upstream of the Feather River Fish Hatchery. The flow over the dam maintains fish habitat in the low-flow channel of the Feather River between the dam and the Thermalito Afterbay Outlet and provides attraction flow for the hatchery. The Feather River Fish Hatchery, an anadromous fish hatchery, was built to compensate for the loss of spawning grounds and rearing areas for returning salmon and steelhead trout and their offspring; the spawning grounds and rearing areas were lost due to construction of Oroville Dam. The hatchery has recently accommodated more than 20,000 adult fish and 15 million young fish annually.

The Oroville Facilities support a wide variety of recreational opportunities. These opportunities include: boating (several types), fishing (several types), fully developed and primitive camping (including boat-in and floating sites), picnicking, swimming, horseback riding, hiking, off-road bicycle riding, wildlife watching, and hunting. There are also visitor information sites with cultural and informational displays about the developed facilities and the natural environment. There are major recreation facilities at Loafer Creek, Bidwell Canyon, Spillway, North and South Thermalito Forebay, and Lime Saddle. Lake Oroville has two full-service marinas, five car-top boat launch ramps, ten floating campsites, and seven dispersed floating toilets. There are also recreation facilities at the Visitor Center and the OWA.

The OWA comprises approximately 11,000-acres west of Oroville that is managed for wildlife habitat and recreational activities. It includes the Thermalito Afterbay and surrounding lands (approximately 6,000 acres) along with 5,000 acres adjoining the Feather River. The 5,000-acre area straddles 12 miles of the Feather River, which includes willow and cottonwood-bordered ponds, islands, and channels. Recreation areas include dispersed recreation (hunting, fishing, and bird watching), plus recreation at developed sites, including Monument Hill Day Use Area, model airplane grounds, three boat launches on Thermalito Afterbay and two on the river, and two primitive camping areas. California Department of Fish and Game's (DFG) habitat enhancement program includes a wood duck nest-box program and dry land farming for nesting cover and improved wildlife forage. Limited gravel extraction also occurs in a number of locations.

2.0 PROJECT OPERATIONS

The licensed Oroville Facilities must operate within the constraints imposed by the much larger SWP, its complex operating rules, and existing environmental commitments. The SWP was authorized by the State Legislature in 1951 to "store runoff in Northern California and deliver to areas of need throughout the State." The SWP is a complex water storage and delivery system, involving 28 dams and reservoirs, 8 hydroelectric power plants (3 of which are pumping-generating plants), 17 pumping plants, and more than 600 miles of pipelines and aqueducts. The SWP is a multipurpose water project, responsible for water supply, flood management, power generation, recreation, and habitat enhancement for fish and wildlife. Notwithstanding its multipurpose nature, the top priorities are water supply and flood control, and power generation is secondary. Water releases from various SWP reservoirs and diversion dams are dictated and controlled by essentially all authorized project purposes. The SWP has conveyed an average annual 2.4 maf of water to the 29 long-term water contractors.

2.1 EXISTING OPERATIONS

Figure B.2.1-1 contains a flow diagram that illustrates the overall Oroville Facilities configuration and primary water storage and release points.

Lake Oroville stores and releases water that flows into the lake from upstream reservoir releases and runoff from the intervening area between Lake Oroville and the upper storage reservoirs. Water is released from Lake Oroville to the Feather River to meet water supply, flood protection, water quality improvement, fish and wildlife enhancement, and recreation requirements. Typically, power is generated when water is released from Lake Oroville through the Oroville Facilities for these purposes, or when the pumped-storage operations at the Hyatt and Thermalito plants are in effect.

Planning and implementing SWP operations is highly dependent on constraints placed upon the Oroville Facilities. The Oroville Facilities' operational planning is performed by the Operations Control Office (OCO). The day-to-day operation of the Oroville Facilities is done through the Oroville Field Division (OFD). Decision-making for SWP operations begins with an overall long range plan for the year. This long-range plan is used to establish general operational objectives and to assess the likelihood of achieving the operational objectives. Operations plans are developed on a weekly basis to meet the overall annual operational objectives. Daily schedules are subsequently developed to meet the weekly operational objectives and are adjusted in real-time as needed to respond to changes in conditions.

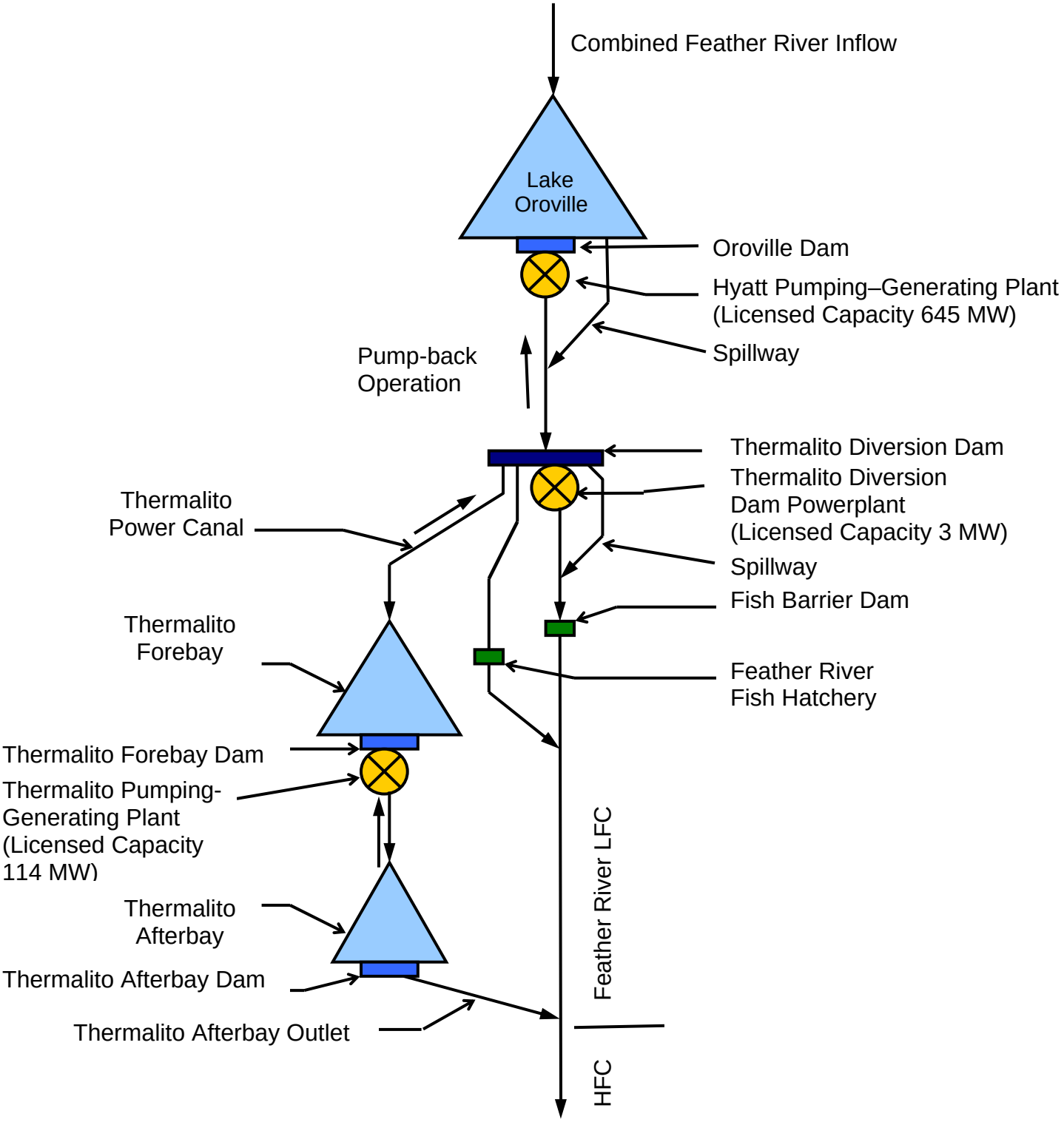


Figure B.2.1-1. Oroville Facilities flow diagram.

2.1.1 Reservoir Operation

DWR stores winter and spring runoff in Lake Oroville for release to the Feather River, as necessary, to meet downstream demands. Annual operations planning is conducted for multiyear carryover, in which half the Lake Oroville storage above the minimum pool is assumed available for subsequent years. The operations plan is updated regularly to reflect changes in hydrology and downstream operations. Typically, Lake Oroville is filled to its maximum annual level of 900 ft. mean sea level (msl) in June and then can be lowered as necessary to meet downstream requirements, to its minimum level in December or January. During and following dry years, the lake may be drawn down more and may not fill to desired levels the following spring. During 1991, 1992, and 1993, (1991 and 1992 were dry years), the minimum elevations were 651 ft., 702 ft., and 723 ft., respectively. During wetter hydrologic conditions, Lake Oroville is managed to control downstream flooding. The U.S. Army Corps of Engineers (USACE) requires Lake Oroville to be operated to maintain up to 750,000 acre-ft. of storage space to capture significant inflows for flood control. Historically, the maximum flood flows released from Lake Oroville were about 160,000 cfs in 1997.

Figure B.2.1-2 below shows average daily lake levels for selected years, illustrating the above operation.

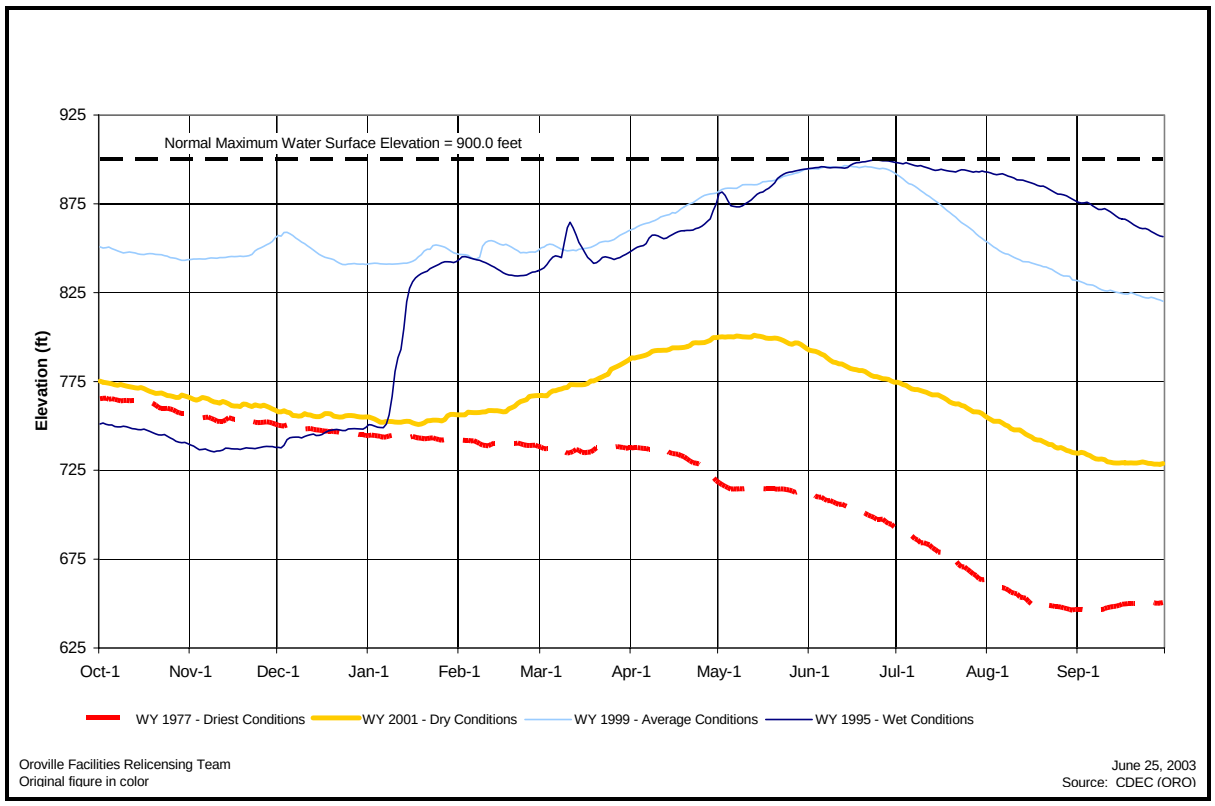


Figure B.2.1-2. Lake Oroville daily elevations.

Figure B.2.1-3 shows Lake Oroville water levels for dry, average, and wet water years. As seen in the figure, the curve showing actual operations generally follows the shape of the flood control rule curve with:

- Lower levels in the late winter and early spring for flood control purposes;
- Higher levels in the late spring and early summer when higher flows may be captured without impacting flood protection; and
- Declining levels in the late summer and fall as the stored water is used.

Actual storage may encroach into the flood reservation during flood events to prevent or minimize downstream flooding along the Feather River. Table B.2.1-1 lists the maximum flow targets at various locations along the Feather River.

Table B.2.1-1. Maximum Feather River flow targets.

Location	Max. Allowable Flow
Below Lake Oroville	150,000 cfs
Above Yuba River	180,000 cfs
Below Yuba River	300,000 cfs
Below Bear River	320,000 cfs

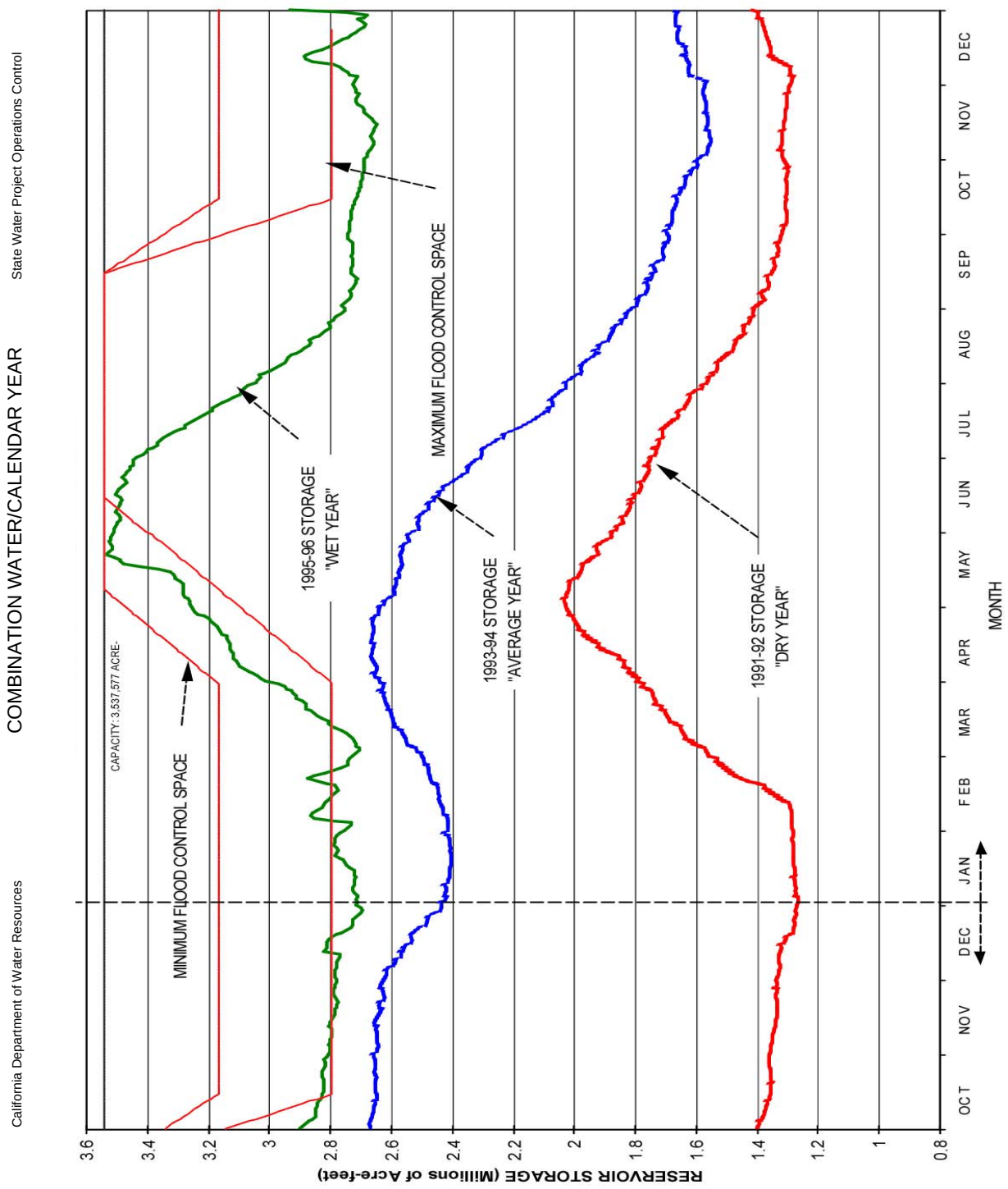
Source: Initial Information Package and Memo from Maurice Roos to Lori Brown dated 7/18/03

2.1.2 Annual Water Operations Planning

Water operations planning requires coordination with other Federal, State, and local agencies and considers many factors. The OCO develops an annual water operations plan that considers forecasted water supply, projected operations of the Central Valley Project, and regulatory (flood management, instream requirements, and water quality) and contractual obligations. Details of the OCO operations are available to the public through the following web site:

http://wwwoco.water.ca.gov

The first official water operations plan is completed in early December of each year as part of the allocation process and is a significant component in determining the amount of forecasted deliveries to SWP contractors. This monthly time-step water operations plan includes projected releases to the Feather River, forecasts of Oroville inflow, Lake Oroville end-of-month storage, and local demands. The water operations plan is updated each month through April to reflect changes in hydrology and downstream operations. The Oroville Facilities power plants operate within the constraints established by the water operations plan.



Source: DWR – Operations Control Office

Figure B.2.1-3. Lake Oroville water levels for dry, average, and wet water years.

2.1.3 Weekly Water Operations Planning

Each week, the OCO develops a general plan for reservoir releases. This plan considers how much water will be needed downstream for: (1) local water supply demands; (2) Delta water quality and quantity requirements; (3) instream flow and temperature requirements; (4) SWP pumping requirements in the Delta; and (5) minimum flood management storage space. The weekly plan is revised as needed to meet changing operational conditions both upstream and downstream.

2.1.4 Daily Water Operations Scheduling

Hourly water releases through the power plants are scheduled daily. The hourly operation of the power plants is planned to maximize the amount of energy that may be produced during periods when electrical demand is highest. Additionally, ancillary services required for participation in the electric utility market and bid into the California Independent System Operator (CAISO) are scheduled on an hourly basis. These ancillary services include regulation up and down, spinning reserves, standby reserves, supplemental energy market, and voltage regulation. The hourly schedule is scheduled to maximize power benefits as long as Oroville Facilities operations fit within the constraints of the overall daily Feather River release objective downstream of Thermalito Afterbay.

2.1.4.1 Releases

Releases from Lake Oroville are scheduled on a weekly basis to accommodate (1) water supply, quality, and quantity requirements in the Sacramento-San Joaquin Delta, (2) instream flow requirements in the Feather River, and (3) minimum flood control space. Weekly operational plans are updated as needed to respond to changing conditions. The Thermalito Diversion Dam Pool and the Thermalito Forebay and Afterbay are too small for seasonal storage so they are used only in weekly and daily operations planning. Releases through the Hyatt and Thermalito Pumping-Generating Plants are scheduled on an hourly basis to maximize the amount of energy produced when power values are highest. Because the downstream water supply is not dependent on hourly releases, and pumping of SWP water can be scheduled at off-peak times, hourly operational decisions are impacted by the following considerations:

- Electrical energy prices and ancillary service requirements such as spinning reserve;
- Supplemental energy market activities; and
- Voltage regulation requirements.

Storage in the Thermalito Forebay and Afterbay is used to generate power and maintain uniform flows in the Feather River downstream of the Oroville Facilities. Thermalito Afterbay also provides storage for pump-back operations. The pump-back operations are designed to use water that is in excess of what is required for downstream flow requirements for pumping back into the Thermalito Forebay and then into Lake Oroville during off-peak hours. This water is then released again during on-peak hours when

power values increase. Generation provided by this pumpback activity contributes on average only about six or seven percent to the total annual Oroville Facilities generation. Because the two main power plants are operated to take advantage of weekday generation when power values are highest, there is usually higher storage in the Afterbay by the end of the week. This is illustrated in Figures B.2.1-4 and B.2.1-5 below. During the weekend, water from the Afterbay continues to be released to the Feather River, generation at the Hyatt and Thermalito Pumping-Generating Plants is decreased, and pump-back operations into Lake Oroville may occur. By the end of the weekend, the elevation of the Afterbay is lowered to prepare for a similar operation the following week.

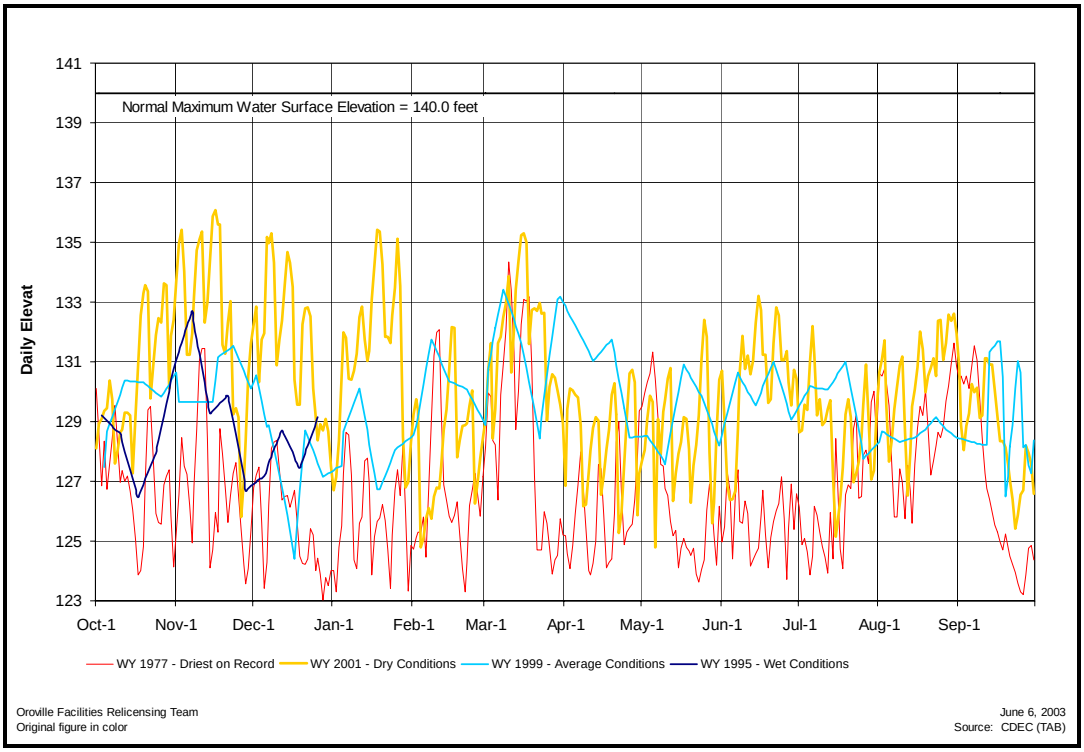


Figure B.2.1-4. Thermalito Afterbay daily elevations.

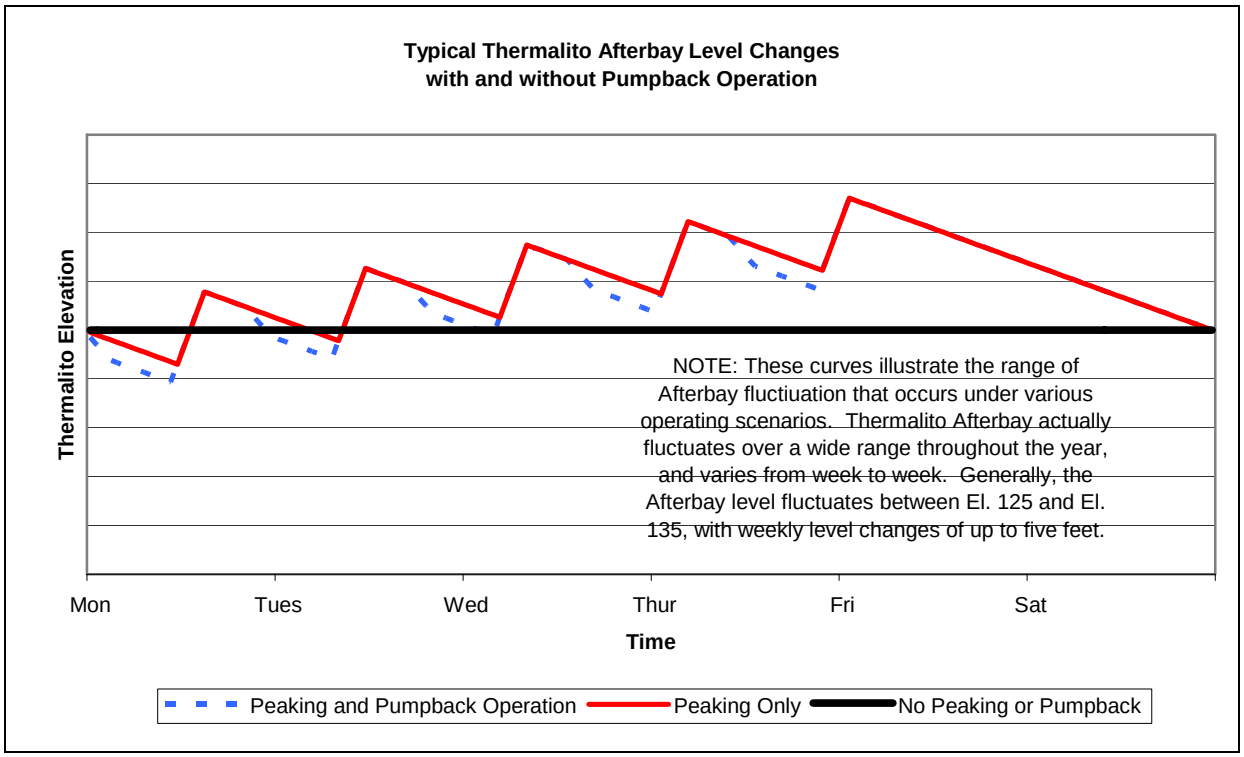


Figure B.2.1-5. Thermalito Afterbay daily reservoir elevations - first full week in April (Monday – Friday).

2.1.4.2 Agricultural Diversions

Monthly agricultural diversions of up to 190,000 af (July 2002) are made from Thermalito Afterbay and the Feather River during the May through August irrigation season. Total annual entitlement of the Butte and Sutter County agricultural users is approximately 1 maf. After meeting these local demands, flows into the lower Feather River continue into the Sacramento River and into the Sacramento-San Joaquin Delta. In the northwestern portion of the Delta, water is pumped into the North Bay Aqueduct. In the south Delta, water is diverted into Clifton Court Forebay where the water is stored until it is pumped into the California Aqueduct.

2.1.4.3 Flood Management

The Oroville Facilities are an integral component of the flood management system for the areas along the Feather and Sacramento Rivers downstream of Oroville Dam. During the wintertime, the Oroville Facilities are operated under flood control requirements specified by the U.S. Army Corps of Engineers (USACE). Under these requirements, Lake Oroville is operated to maintain up to 750,000 af of storage space to allow for the capture of significant inflows. Flood control releases are based on the release schedule in the flood control diagram or the emergency spillway release diagram prepared by the USACE, whichever requires the greater release. Decisions regarding such releases are made in consultation with the USACE.

The flood control requirements are designed for multiple use of reservoir space. During times when flood management space is not required to accomplish flood management objectives, the reservoir space can be used for storing water. From October through March, the maximum allowable storage limit (point at which specific flood release would have to be made) varies from about 2.8 to 3.2 maf to ensure adequate space in Lake Oroville to handle flood flows. The actual encroachment demarcation is based on a wetness index, computed from accumulated basin precipitation. This allows higher levels in the reservoir when the prevailing hydrology is dry while maintaining adequate flood protection. When the wetness index is high in the basin (i.e., wetness in the watershed above Lake Oroville), the flood management space required is at its greatest amount to provide the necessary flood protection. From April through June, the maximum allowable storage limit is increased as the flooding potential decreases, which allows capture of the higher spring flows for use later in the year. During September, the maximum allowable storage decreases again to prepare for the next flood season. During flood events, actual storage may encroach into the flood reservation zone to prevent or minimize downstream flooding along the Feather River.

Table B.2.1-2 presents the significant spills of record. During the largest flood record in early 1997, the estimated peak downstream release was 160,000 cfs for a short time, much less than the peak storm inflow of 302,000 cfs. In the large February 1986 flood, peak inflow to Lake Oroville was estimated to be about 266,000 cfs, and maximum complex releases were 150,000 cfs. Most of these releases came through the dam spillway but some were made via the Hyatt Pumping-Generating Plant. As spillway amounts increase over 60,000 cfs, the local backwater effect begins to limit powerplant production. The spillway volume releases shown in the table do not include flow through the plant. However, the maximum release is the total release to the river, including flows from Thermalito Afterbay Outlet. The maximum river release will usually lag the peak bi-hourly inflow because the initial flood surge is stored in Lake Oroville and downstream release increases are limited by the Corps of Engineers to not exceed increments of 10,000 cfs every two hours.

Table B.2.1-2. Significant spills of record.

Spill Begin	Period End	Peak Release (cfs)	Total Release (af)	Peak Inflow (cfs)
1-13-70	2-02-70	77,000	1,563,000	147,000
1-12-80	1-20-80	85,000	726,000	155,000
2-15-86	3-01-86	150,000	1,420,000	266,000
3-09-95	3-27-95	87,000	1,235,000	141,000
12-27-96	1-17-97	160,000	2,013,000	302,000

Note: Most of the spills shown in the table occurred over the Oroville Dam Spillway, but some releases were made through the Hyatt Pumping-Generating Plant. The spill flows do not include maximum releases through Hyatt Pumping-Generating Plant of up to 16,950 cfs.
Source: Memo from Maurice Roos to Lori Brown dated 7/18/03

2.2 EXISTING ENVIRONMENTAL AND RECREATION COMMITMENTS

Operation of the Oroville Facilities varies seasonally, weekly and hourly, depending on hydrology and the operational objectives DWR is trying to meet. Typically, releases to the Feather River are managed to conserve water while meeting a variety of water delivery requirements, including upstream and downstream flows, temperature, fisheries, recreation, agricultural diversions and water quality. Lake Oroville stores winter and spring runoff for release to the Feather River as necessary for project purposes. Meeting the water supply objectives of the SWP has always been the primary consideration for determining Oroville Facilities' operations (within the regulatory constraints specified for flood control, in-stream fisheries, and downstream uses). Power production is scheduled within the boundaries specified by the water operations criteria noted above. Annual operations planning is conducted for multi-year carry over. The current methodology is to retain half of Lake Oroville's storage above a specific level for subsequent years. Currently, that level has been established at 1,000,000 acre-feet (af); however, this does not limit draw down of the reservoir below that level. If hydrologic data show it to be a drier year than expected or operational requirements are greater than expected, additional water would be released from Lake Oroville. The operations plan is updated regularly to reflect changes in hydrology and downstream requirements. Typically, Lake Oroville is filled to its maximum annual level of up to 900 ft above mean sea level (msl) in June and then can be lowered as necessary to meet downstream requirements, to its minimum level in December or January. During drier years, the lake may be drawn down more and may not fill to the desired levels the following spring. Oroville Facilities operations are directly constrained by downstream environmental and flood management criteria as described below.

2.2.1 Fish and Wildlife Management

An August 1983 agreement between DWR and DFG entitled, "Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife," sets criteria and objectives for flow and temperatures in the low flow channel and the reach of the Feather River between Thermalito Afterbay and Verona. This agreement: (1) establishes minimum flows between Thermalito Afterbay Outlet and Verona which vary by water year type; (2) requires flow changes under 2,500 cfs to be reduced by no more than 200 cfs during any 24-hour period, except for flood management, failures, etc.; (3) requires flow stability during the peak of the fall-run Chinook spawning season; and (4) sets an objective of suitable temperature conditions during the fall months for salmon and during the later spring/summer for shad and striped bass.

2.2.1.1 Instream Flow Requirements

The Oroville Facilities are operated to meet minimum flows in the Lower Feather River as established by the 1983 agreement (see above). The agreement specifies that Oroville Facilities release a minimum of 600 cfs into the Feather River from the Thermalito Diversion Dam for fisheries purposes. This is the total volume of flows from

the Thermalito Diversion Dam Powerplant, and the Feather River Fish Hatchery pipeline.

Generally, the instream flow requirements below Thermalito Afterbay are 1,700 cfs from October through March, and 1,000 cfs from April through September. However, if runoff for the previous April through July period is less than 1,942,000 af (i.e., the 1911-1960 mean unimpaired runoff near Oroville), the minimum flow can be reduced to 1,200 cfs from October to February, and 1,000 cfs for March. A maximum flow of 2,500 cfs is maintained from October 15 through November 30 to prevent spawning in overbank areas that might become de-watered.

2.2.1.2 Feather River Temperature Requirements

The Diversion Pool provides the water supply for the Feather River Fish Hatchery. The hatchery objectives are 52°F for September, 51°F for October and November, 55°F for December through March, 51°F for April through May 15, 55°F for the last half of May, 56°F for June 1-15, 60°F for June 16 through August 15, and 58°F for August 16-31. A temperature range of plus or minus 4°F is allowed for objectives, April through November.

There are several temperature objectives for the Feather River downstream of the Thermalito Afterbay Outlet. During the fall months, after September 15, the temperatures must be suitable for fall-run Chinook. From May through August, they must be suitable for shad, striped bass, and other warm water fish.

The National Oceanic and Atmospheric Administrations (NOAA) Fisheries (formerly National Marine Fisheries Service) has also established an explicit criterion for steelhead trout and spring-run Chinook salmon. Memorialized in a biological opinion on the effects of the Central Valley Project and SWP on Central Valley spring-run Chinook and steelhead as a reasonable and prudent measure; DWR is required to control water temperature at Feather River mile 61.6 (Robinson Riffle in the low-flow channel) from June 1 through September 30. This measure requires water temperatures less than or equal to 65°F on a daily average. The requirement is not intended to preclude pump-back operations at the Oroville Facilities needed to assist the State of California with supplying energy during periods when the California ISO anticipates a Stage 2 or higher alert.

The hatchery and river water temperature objectives sometimes conflict with temperatures desired by agricultural diverters. Under existing agreements, DWR provides water for the Feather River Service Area (FRSA) contractors. The contractors desire warmer water during spring and summer for rice germination and growth (i.e., 65°F from approximately April through mid May, and 59°F during the remainder of the growing season). To the extent practical, DWR does use its operational flexibility to accommodate the FRSA contractor's temperature goals.

2.2.2 Sacramento-San Joaquin Delta Water Quality Control

Flows through the Delta are maintained to meet Bay-Delta water quality standards arising from DWR's water rights permits. These standards are designed to meet several water quality objectives such as salinity, Delta outflow, river flows, and export limits. The purpose of these objectives is to attain the highest water quality, which is reasonable, considering all demands being made on the Bay-Delta waters. In particular, they protect a wide range of fish and wildlife including Chinook salmon, Delta smelt, striped bass, and the habitat of estuarine-dependent species.

2.2.3 Feather River Fish Hatchery Operations

Water is also released from the Oroville Facilities storage reservoirs to support fish hatchery operations downstream of the Fish Barrier Dam. The design of the facilities provides for significant flexibility to enable water temperature control as described below. Feather River Fish Hatchery temperature objectives are listed in Table B.2.2-1.

Table B.2.2-1. Feather River Fish Hatchery water temperature objectives.

Period	Temperature (+/- 4°F)
April 1 – May 15	51°
May 16 – May 31	55°
June 1 – June 15	56°
June 16 – August 15	60°
August 16 – August 31	58°
September 1 – September 30	52°
October 1 – November 30	51°
December 1 – March 31	55°

Hyatt Pumping-Generating Plant Operations - Temperature Control

- Water temperature of releases from Lake Oroville can be regulated to meet water temperature objectives downstream as a result of the multi-level intake structures.
- Two multi-level intake structures serve the six Hyatt units, each consisting of sloping structures with 13 control shutters and ranging in elevation from about 650 – 900 ft Intake No. 1 serves Units 1 – 3 and Intake No. 2 serves Units 4 – 6.
- The intake structures in Lake Oroville serve as diffusers of water pumped-back from Diversion Pool.

Diversion Pool - Flow Releases to Support the Feather River Fish Hatchery

- Flows through the hatchery range from about 30 – 130 cfs depending on hatchery operations, considering factors such as operations supporting seasonal migrations, fish population (number of rearing ponds in use), and life stages of the fish.
- The 1983 Agreement also specifies water temperature objectives that must be met within a deviation of plus or minus 4°F during April 1 – November 30.

- The water temperatures are facilitated by the use of a shutter controlled intake gate system in Lake Oroville which provides for withdrawing water of varying temperatures from different depths of the reservoir, blended with warmer water pumped-back from Thermalito Afterbay.
- Hyatt and Thermalito Pumping-Generating Plant operations for generation versus pumping modes can be influenced by these temperature objectives.

Diversion Pool - Temperature Control

- Diversion Pool serves as the primary location for monitoring the mixing of warmer and cooler water temperatures for meeting the downstream temperature requirements at the Feather River Fish Hatchery and Robinson Riffle.
- During the course of generating and pump-back operations, warmer water can be introduced into the pool when pumping back through Thermalito Pump-Generating Plant, while cooler water can be introduced when generating through Hyatt Pumping-Generating Plant.
- Meeting temperature requirements can sometimes dictate the timing of pumping and generation operations at the Oroville Facilities.

Thermalito Diversion Dam Powerplant Operations

- The instream flow requirement is to maintain at all times a minimum of 600 cfs combined flow through Thermalito Diversion Dam Powerplant, diversion dam outlet and Feather River Fish Hatchery.
- The requirement is a result of the 1983 Agreement between DWR and CDFG, Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish & Wildlife (1983 Agreement).

2.2.4 Recreational Facilities

The majority of recreation facilities in the project area are within the Lake Oroville State Recreation Area (LOSRA), which has numerous facilities and sites that offer diverse recreational opportunities. LOSRA, managed by DPR, includes Lake Oroville and the surrounding lands and facilities within the project area, as well as the land and waters in and around the Diversion Pool and Thermalito Forebay, downstream of Oroville Dam. Lake Oroville is one of the largest lakes in California, with over 15,000 surface acres at full pool. The Diversion Pool and Thermalito Forebay are stable, with cool water reservoirs of 320 and 630 acres, respectively. Therefore, project operation to meet recreational use needs is an important consideration.

There are also recreational facilities and opportunities within the project area but outside LOSRA, specifically at the Thermalito Afterbay, Oroville Wildlife Area (OWA), and at the Feather River Fish Hatchery. Thermalito Afterbay is a 4,300-acre, shallow reservoir that receives water released from Lake Oroville and passes through Thermalito Forebay and Diversion Pool and associated power plants and canals. Descriptions of OWA and the Feather River Fish Hatchery and their operation are provided below.

The most popular activities in the project area include swimming, motorboating, bank fishing, water skiing and wakeboarding, boat fishing, use of personal watercraft, tent camping, houseboating, horseback riding, picnicking, recreational vehicle (RV) camping, and hiking.

2.3 PROPOSED OPERATIONS

No major upgrades are proposed for the Oroville Facilities, although it is anticipated that the pump units or turbines may be replaced at Thermalito Diversion Dam Powerplant or Thermalito Pumping-Generating Plant. On-going maintenance will include minor upgrades as necessary to maintain the facilities.

No operational changes are planned by DWR as part of the Proposed Action described in Chapter 3 of the PDEA submitted with this Application.

3.0 CAPACITIES, RATINGS, POWER PRODUCTION AND SUPPORTING DATA

3.1 MEAN, MINIMUM AND MAXIMUM FLOWS

Table B.3.1-1. Historical inflow to Lake Oroville.

(cfs)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	8,427	10,948	11,686	8,996	7,693	4,509	2,612	2,170	2,181	2,339	3,864	6,087
Max	276,552	200,537	110,245	83,860	88,773	22,862	9,290	5,521	6,723	11,137	69,998	171,347
Min	180	373	1,830	1,296	522	48	0	42	6	21	186	143

Source: DWR-O&M Project Records and Report section. Data from Jan 1st, 1979 to Jan 31, 2001

See Appendix A: Annual and Monthly Flow versus Duration for Inflow of Lake Oroville.

3.2 AREA-CAPACITY CURVES FOR RESERVOIRS AND FOREBAYS

Following are Area-Capacity curves for the following impoundments:

- Lake Oroville
- Diversion Pool
- Thermalito Forebay
- Thermalito Afterbay

3.2.1 Lake Oroville

The following data were used to prepare the Lake Oroville Area-Capacity Curves shown in Figure B.3.2-1.

Table B.3.2-1. Area-Capacity for Lake Oroville.

Area (acres)	**Elevation** (feet)	**Capacity** (af)	**Area** (acres)	**Elevation** (feet)	**Capacity** (af)
3,074	520	328,458	8,279	720	1,413,689
3,258	530	360,109	8,620	730	1,498,174
3,454	540	393,661	8,967	740	1,586,087
3,659	550	429,216	9,328	750	1,677,554
3,875	560	466,879	9,689	760	1,772,690
4,100	570	506,733	10,074	770	1,871,515
4,323	580	548,836	10,472	780	1,974,241
4,554	590	593,213	10,874	790	2,080,970
4,795	600	639,950	11,281	800	2,191,742
5,044	610	689,134	11,691	810	2,306,596
5,302	620	740,852	12,113	820	2,425,574
5,565	630	795,177	12,543	830	2,548,850
5,839	640	852,196	12,969	840	2,676,447
6,117	650	911,974	13,413	850	2,808,348
6,400	660	974,559	13,868	860	2,944,745
6,689	670	1,040,005	14,334	870	3,085,746
6,993	680	1,108,409	14,813	880	3,231,454
7,309	690	1,179,914	15,305	890	3,382,038
7,634	700	1,254,632	15,801	900	3,537,577
7,951	710	1,332,547	16,344	910	3,698,295
			16,731	917	3,814,054

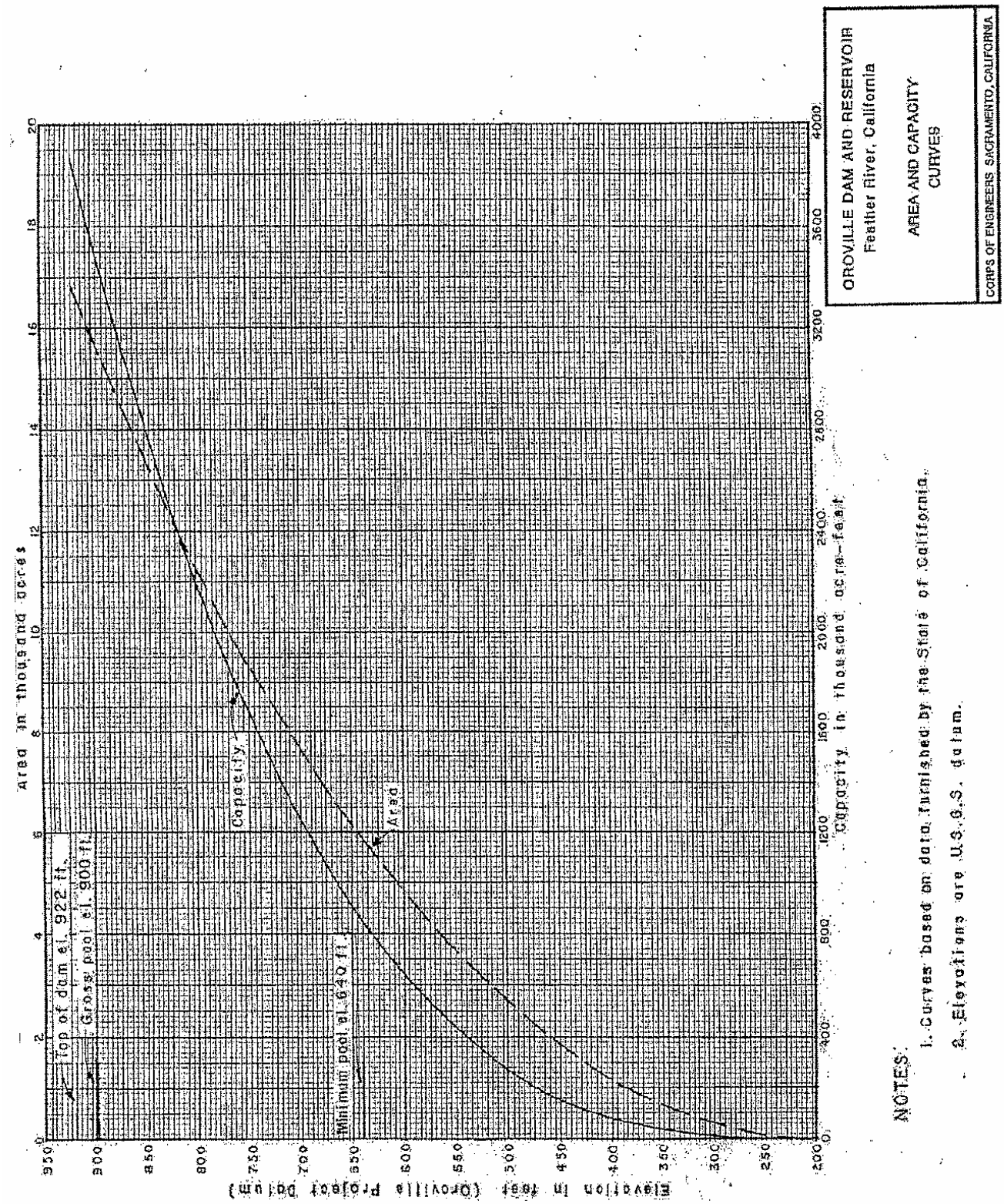


Figure B.3.2-1. Oroville Dam and Reservoir – Area-Capacity Curves.

3.2.2 Diversion Pool

The following data were used to prepare the Diversion Pool Area-Capacity Curves shown in Figure B.3.2-2.

Table B.3.2-2. Area-Capacity for Diversion Pool.

Area (acres)	**Elevation** (feet)	**Capacity** (af)
0	136	0
8	140	16
16	145	76
26	150	176
41	155	344
59	160	594
78	165	935
99	170	1,377
118	175	1,930
145	180	2,589
171	185	3,380
195	190	4,296
215	195	5,326
232	200	6,444
249	205	7,647
266	210	8,936
285	215	10,313
304	220	11,785
323	225	13,353
343	230	15,018
347	231	15,363

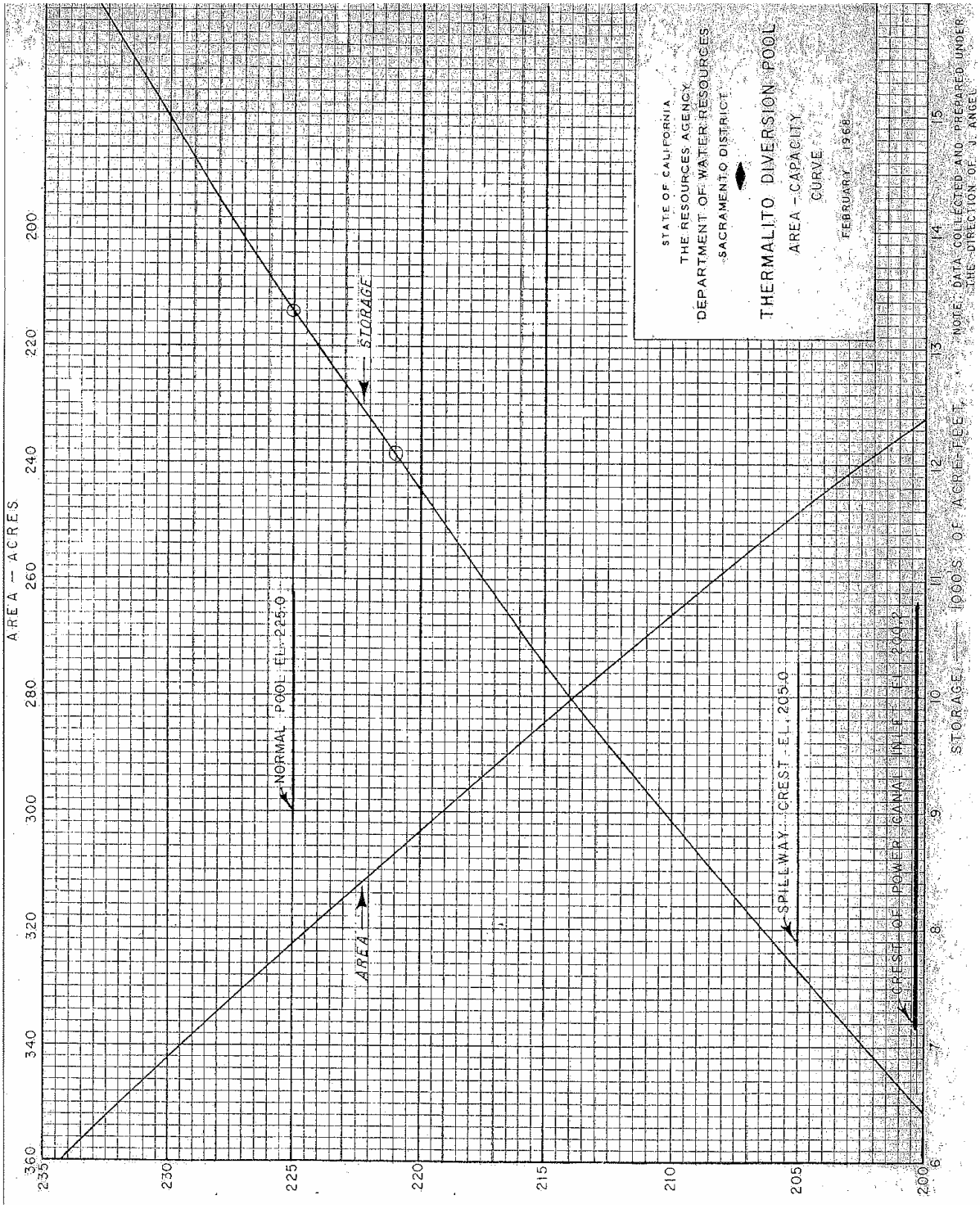


Figure B.3.2-2. Diversion Pool – Area-Capacity Curves.

3.2.3 Thermalito Forebay

The following data were used to prepare the Thermalito Forebay Area-Capacity Curves shown in Figure B.3.2-3.

Table B.3.2-3. Area-Capacity for Thermalito Forebay.

Area (acres)	**Elevation** (feet)	**Capacity** (af)
1	178	0
1	180	2
5	185	15
29	190	95
85	195	363
202	200	1,115
286	205	2,341
375	210	3,993
483	215	6,126
568	220	8,776
630	225	11,768
698	230	15,083
713	231	15,789

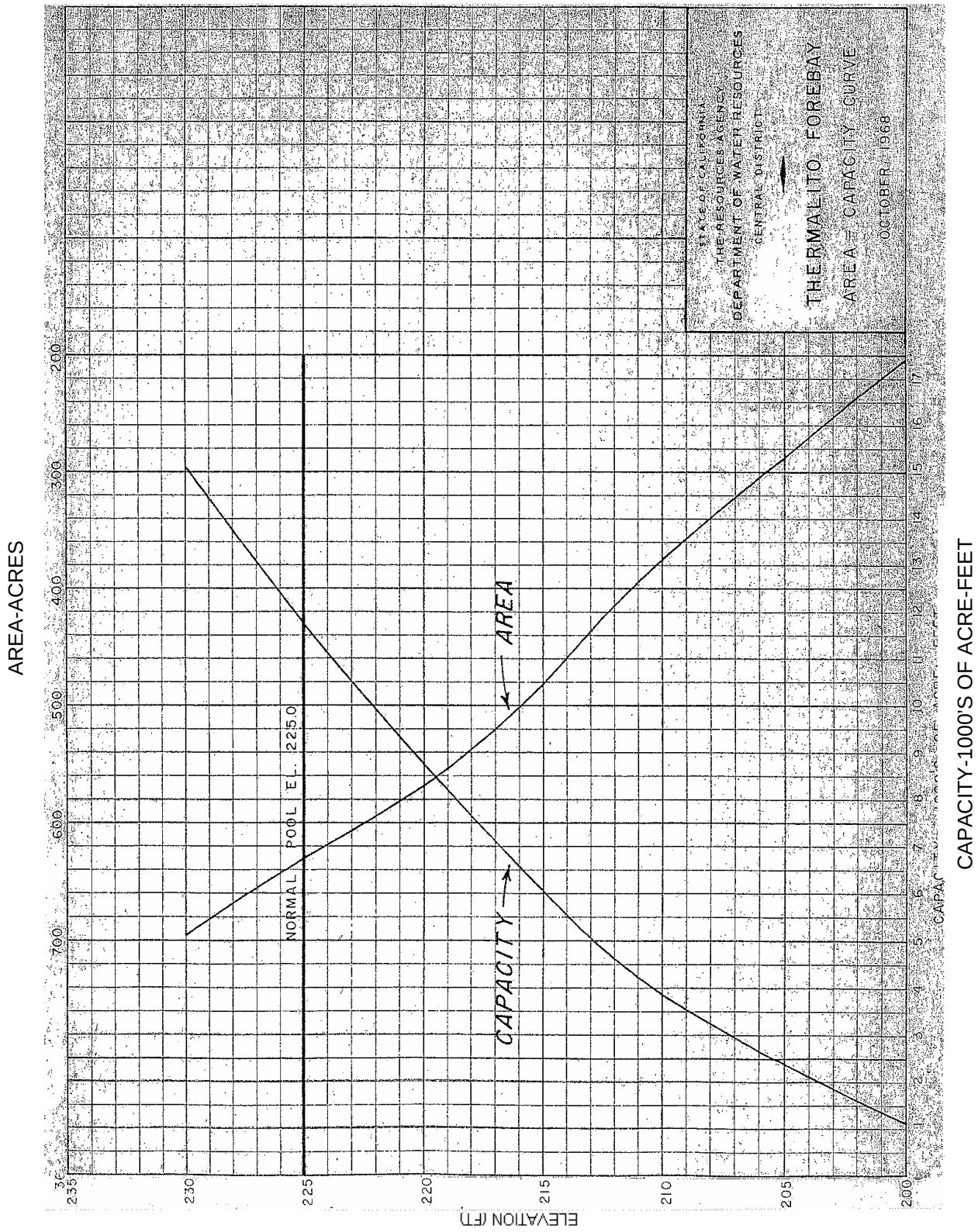


Figure B.3.2-3. Thermalito Forebay – Area-Capacity Curves.

3.2.4 Thermalito Afterbay

The following data were used to prepare the Thermalito Afterbay Area-Capacity Curves shown in Figure B.3.2-4.

Table B.3.2-4. Area-Capacity for Thermalito Afterbay.

Area (acres)	**Elevation** (feet)	**Capacity** (af)
6	95	0
14	100	49
20	105	137
73	110	306
564	115	1,573
1,714	120	7,056
2,508	125	17,581
3,324	130	32,151
4,094	135	50,739
4,901	142	82,490

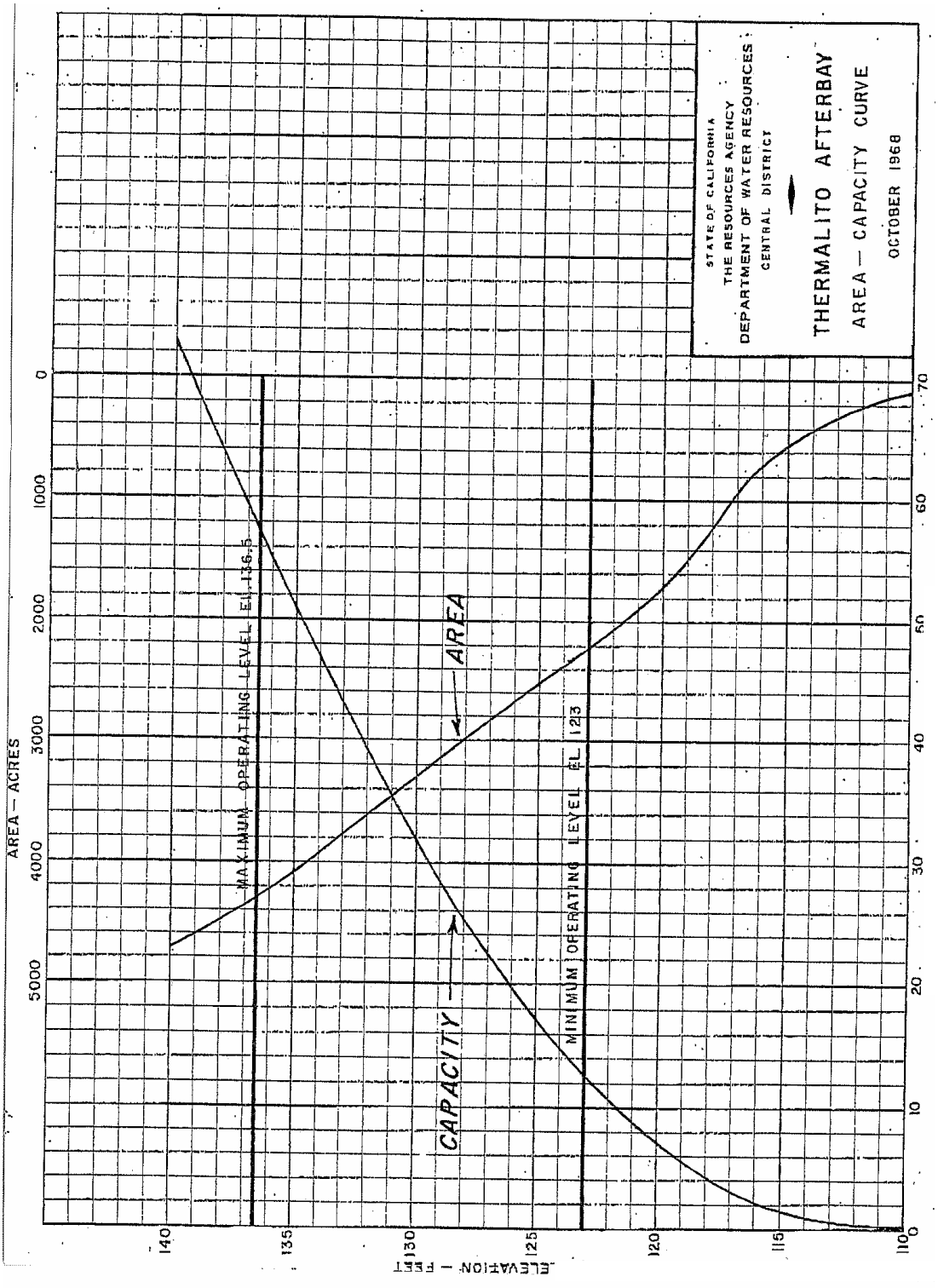


Figure B.3.2-4. Thermalito Afterbay – Area-Capacity Curves.

3.3 HYDRAULIC CAPACITIES OF POWER PLANTS

3.3.1 Hyatt Pumping-Generating Plant

- Maximum generating release 16,950 cfs
- Maximum pumping capacity 5,610 cfs
- Minimum generating release 2,400 cfs

3.3.2 Thermalito Diversion Dam Powerplant

- Maximum generating release 615 cfs
- Minimum generating release 400 cfs

3.3.3 Thermalito Pumping-Generating Plant

- Maximum generating release 17,400 cfs
- Maximum pumping capacity 9,120 cfs
- Minimum generating release 3,700 cfs

3.4 TAILWATER RATING CURVES FOR POWER PLANTS

In general, the tailwater at the three plants of the Oroville Facilities is not related to the discharge flow through the plant. It depends on the downstream structure and remains relatively constant.

3.4.1 Hyatt Pumping-Generating Plant

The tailwater conditions at Hyatt Pumping-Generating Plant are defined by the Diversion Pool. The Diversion Pool extends up to the Hyatt outlet portals, located at the Hyatt Pumping-Generating Plant. The Diversion Pool elevation ranges from elevation 221.0 minimum to elevation 225.0 maximum and is independent of the flow through Hyatt Pumping-Generating Plant.

3.4.2 Thermalito Diversion Dam Powerplant

The nominal tailwater conditions at Thermalito Diversion Dam Powerplant are essentially defined by the fixed elevation of the Fish Barrier Dam.

3.4.3 Thermalito Pumping-Generating Plant

The tailwater conditions at Thermalito Pumping-Generating Plant are defined by the elevation of Thermalito Afterbay, which operates in the range between elevation 123.0 ft and elevation 136.5 ft. This Afterbay elevation is unaffected by the flow through Thermalito Pumping-Generating Plant.

3.5 POWER PLANT CAPACITY VS. HEAD

The maximum power plant capacities and maximum and minimum static heads are shown in Table B.3.5-1.

Table B.3.5-1. Power Plant capacity vs. head.

	Hyatt Pumping-Generating Plant	Thermalito Diversion Dam Powerplant	Thermalito Pumping-Generating Plant
Maximum Capacity	679 MW	3 MW	120 MW
Maximum Static Head	676 ft	77 ft	102 ft
Minimum Static Head	410 ft	63 ft	85 ft

4.0 UTILIZATION OF PROJECT POWER

4.1 HYDROPOWER OPERATION

Releases from Lake Oroville are routed through the Hyatt Pumping-Generating Plant into the Feather River for power generation. Releases that exceed Feather River instream requirements flow into the Thermalito Forebay. The portion of the water released to meet instream requirements is discharged through Thermalito Diversion Dam Powerplant or through the spillway. The water in the Thermalito Forebay is routed through the Thermalito Pumping-Generating Plant into Thermalito Afterbay. Inflow to Thermalito Afterbay from peak power generation, in excess of local and downstream requirements, is stored for later release to the river. If energy price and availability factors are favorable, the water stored in Thermalito Afterbay may be pumped back through Thermalito Pumping-Generation Plant and Hyatt Pumping-Generating Plant into Lake Oroville during off-peak hours. Operation in a pumped storage mode most commonly occurs when energy values are high during weekday on-peak hours (when water is released at Oroville for peak power generation) and low during the weekday off-peak hours or on the weekend (when water is pumped back into Lake Oroville for subsequent power generation).

Operations of the Oroville Facilities are planned and scheduled in concert with other SWP facilities. Its water meets local and downstream demands when unregulated flows alone are not enough to satisfy those needs. Operation of the Oroville Facilities varies seasonally, weekly, and hourly depending on hydrology and current operational objectives. Typically, releases to the Feather River are managed to conserve water while meeting instream, Sacramento-San Joaquin Delta, and SWP requirements including flow, temperature, fisheries, recreation, water quality, and agricultural diversions.

Local water supply diversions take water directly from Thermalito Afterbay. The total capacity of Thermalito Afterbay diversions during periods of peak water supply demands is 4,050 cfs. The Oroville Facilities have a capacity of approximately 17,000 cfs through the power plants, which can be returned to the Feather River via the Thermalito Afterbay Outlet.

4.2 POWER TRANSACTIONS

Overall, the SWP uses more energy than it produces. To balance SWP loads with available resources, DWR relies upon a suite of options that include purchases from the day-ahead, and hour-ahead markets; capacity exchanges; and energy contracts (both short and long-term). Two such contracts with Southern California Edison Company (SCE) allow DWR to exchange on-peak capacity and energy for off-peak energy that may be used elsewhere within the SWP system. Specifically, under the terms of the 1979 Power Contract and the 1981 Capacity Exchange Agreement, DWR provides SCE with up to 350 MW of capacity and approximately 40 percent of the energy from the Oroville Facilities. In return, DWR receives off-peak energy from SCE equal to the amount of energy provided to SCE from the Oroville Facilities, plus an additional

amount of energy as payment for the on-peak capacity. The amount of additional energy is determined annually based on the Capacity-Energy Exchange Formula defined in the 1979 Power Contract.

Several power purchases and sales agreements, the largest of which are the SCE power and capacity exchange contracts, expire on December 31, 2004; a different portfolio of generation resources will be made available to meet SWP energy and capacity requirements starting January 1, 2005. DWR is involved in solicitation and confidential negotiation efforts with a variety of providers of generation capacity and energy. The results of solicitation and negotiations were not available at the time this document was prepared.

Additionally, ancillary services required for participation in the electric utility market and bid into the California Independent System Operator (CAISO) are also scheduled on an hourly basis. These services include spinning reserve, non-spinning reserve, supplemental energy market, and regulation.

4.3 LOAD MANAGEMENT

The SWP controls the timing of its pumping load through an extensive computerized network. This control system allows DWR to minimize the cost of power it purchases by maximizing pumping during off-peak periods when power costs are lower—usually at night—and by selling power to other utilities during on-peak periods when power values are high. By taking advantage of this flexibility in scheduling SWP pumping load and generation, DWR reduces the net cost for SWP water deliveries.

When generation from the Oroville Facilities exceeds SWP load requirements, DWR sells the excess power on the market. Currently, DWR contracts with utilities and marketers for short-term purchase, sale, or exchange of power. In addition to selling firm power, DWR may sell power on a day-to-day or hour-to-hour basis according to the terms of its interchange agreements and the Western System Power Pool agreement. These agreements provide the basis for making energy transactions, short-term capacity and energy sales or exchanges, unit commitments, and transmission service purchases.

4.4 HISTORICAL ANNUAL GENERATION

Hydroelectric generation provides the largest share of SWP power resources. However, hydroelectric generation at the Oroville Facilities is greatly affected by the amount of annual runoff to the Feather River watershed. The combined 762 MW Hyatt and Thermalito Pumping-Generating Plants generate about 2.2 billion kWh in a median water year (DWR 1999). The 3 MW output from the Thermalito Diversion Dam Powerplant adds another 24 million kWh a year. Over the past 20 years, the range of generation has varied from below 1 million MWh in 1991 and 1992 (critically dry years) to over 4 million MWh in 1982-1983 (very wet years).

Monthly generation made available to the SWP in recent years (Calendar year 1982 through 2001) from the Oroville Facilities operation is summarized in Table B.4.4-1 below. This generation data represents the combined generation output from Hyatt Pumping-Generating Plant, Thermalito Pumping-Generating Plant, and Thermalito Diversion Dam Powerplant. The average for this 20-year period was 2.4 billion kWh per year.

Table B.4.4-1. Energy generation at Oroville Facilities [a, b] (in MWh).

Year	January	February	March	April	May	June	July	August	September	October	November	December	Total
1982	429,640	395,540	454,680	571,280	436,870	280,310	267,590	327,870	255,520	155,500	162,840	343,190	4,080,830
1983	344,020	465,550	567,570	569,240	545,240	465,220	367,900	310,930	263,430	149,210	296,980	557,690	4,902,980
1984	432,360	216,240	246,130	153,470	212,480	244,120	359,760	248,730	170,750	97,870	86,320	173,210	2,641,440
1985	81,480	98,750	93,450	123,000	285,390	285,710	264,980	190,870	71,530	104,620	75,680	40,330	1,715,790
1986	44,320	303,700	536,720	148,440	169,870	167,340	313,110	223,160	201,880	154,050	99,610	88,310	2,450,510
1987	82,620	51,730	57,870	120,870	165,600	192,200	239,710	164,320	101,190	74,520	69,730	69,340	1,389,700
1988	55,790	60,740	135,000	162,760	132,290	189,830	241,440	160,820	129,880	102,970	101,290	78,990	1,551,800
1989	64,460	96,390	71,340	62,780	185,710	209,650	358,240	284,110	146,060	108,410	109,780	217,250	1,914,180
1990	117,730	84,180	107,930	260,020	176,890	134,450	189,070	174,740	54,550	46,760	44,910	123,940	1,515,170
1991	48,890	23,140	22,070	21,300	123,030	159,430	135,410	73,920	53,710	49,390	33,450	67,410	811,150
1992	32,070	19,510	55,580	21,100	143,540	119,620	138,680	112,210	90,790	51,850	35,660	47,000	867,610
1993	24,470	48,070	357,360	287,330	286,590	296,330	380,550	363,150	107,230	103,550	124,790	241,450	2,620,870
1994	77,790	51,690	76,010	125,150	168,380	185,180	215,560	172,930	137,850	120,330	80,100	89,490	1,500,460
1995	195,790	396,770	452,970	464,890	498,360	490,320	271,230	304,380	292,480	149,930	125,740	233,660	3,876,520
1996	233,350	506,610	347,130	361,980	384,560	275,610	382,600	301,530	113,110	122,280	131,500	432,230	3,592,490
1997	456,210	390,660	138,180	114,530	200,590	258,450	402,520	254,240	129,520	162,090	117,750	103,710	2,728,450
1998	250,090	470,160	420,670	324,010	383,020	423,400	343,630	325,400	263,780	155,810	97,970	411,110	3,869,050
1999	268,034	457,775	307,517	157,986	210,662	191,981	465,021	280,865	164,538	152,924	127,640	162,475	2,947,418
2000	108,927	259,837	369,124	175,572	245,297	281,055	384,404	308,198	175,189	165,647	150,533	133,188	2,756,871
2001	97,975	57,222	79,772	78,292	192,980	162,097	149,266	139,137	55,685	89,236	63,770	69,149	1,234,581

Source:

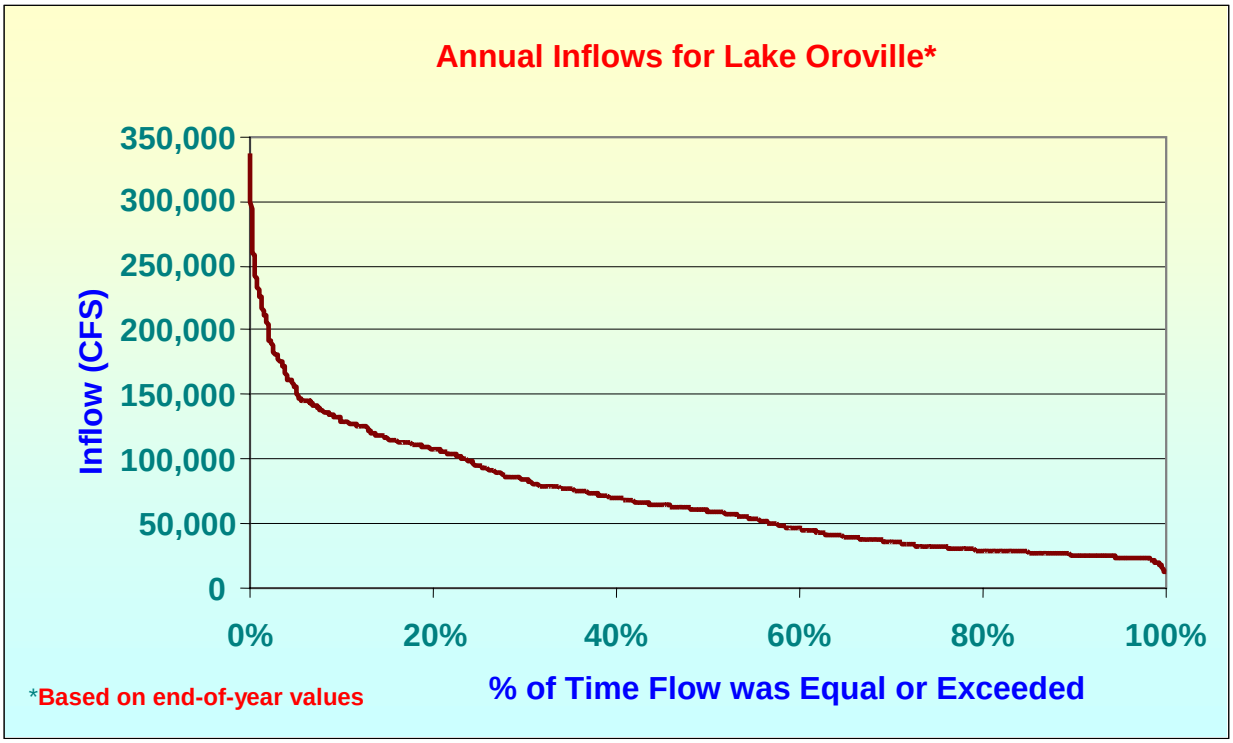
a. Generation amounts obtained from Table 10-2, Energy Generated and Purchased, by Month*, Bulletin 132.*

b. Oroville Facilities include Hyatt, Thermalito, and Thermalito Diversion Dam Power Plants.

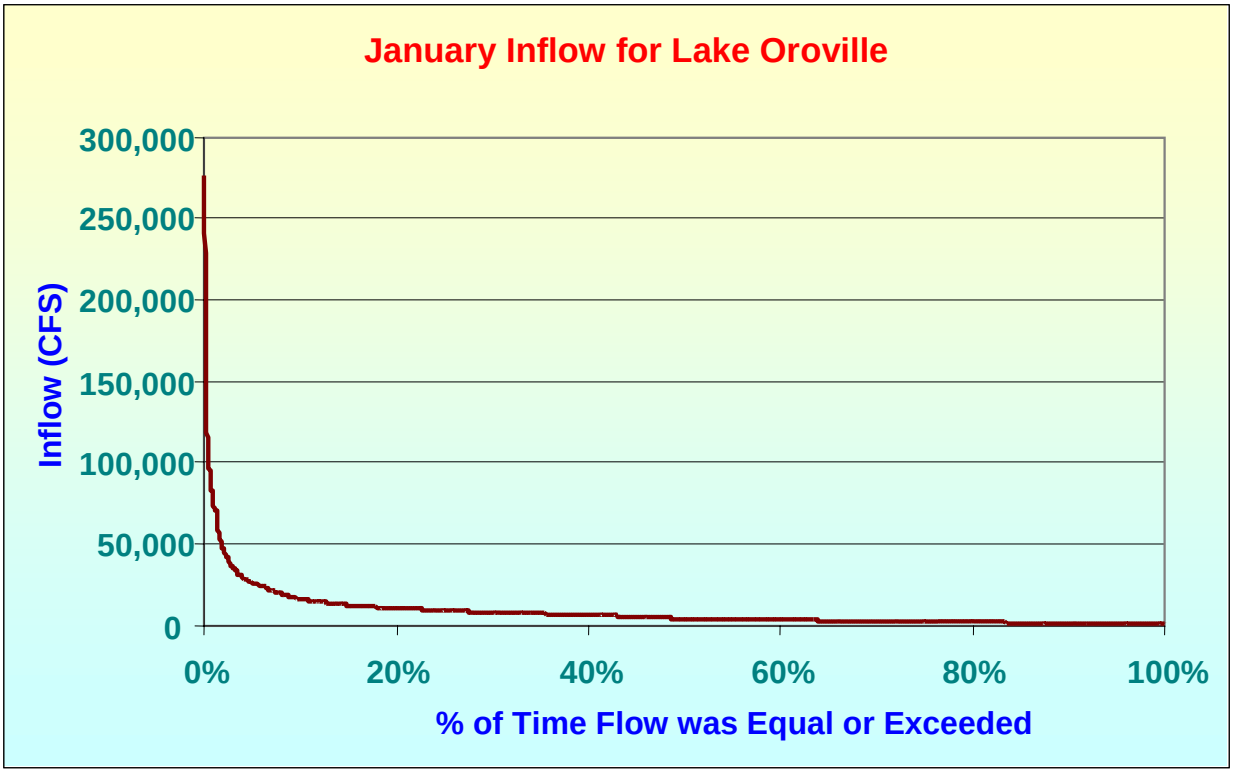
5.0 PLANS FOR FUTURE DEVELOPMENT

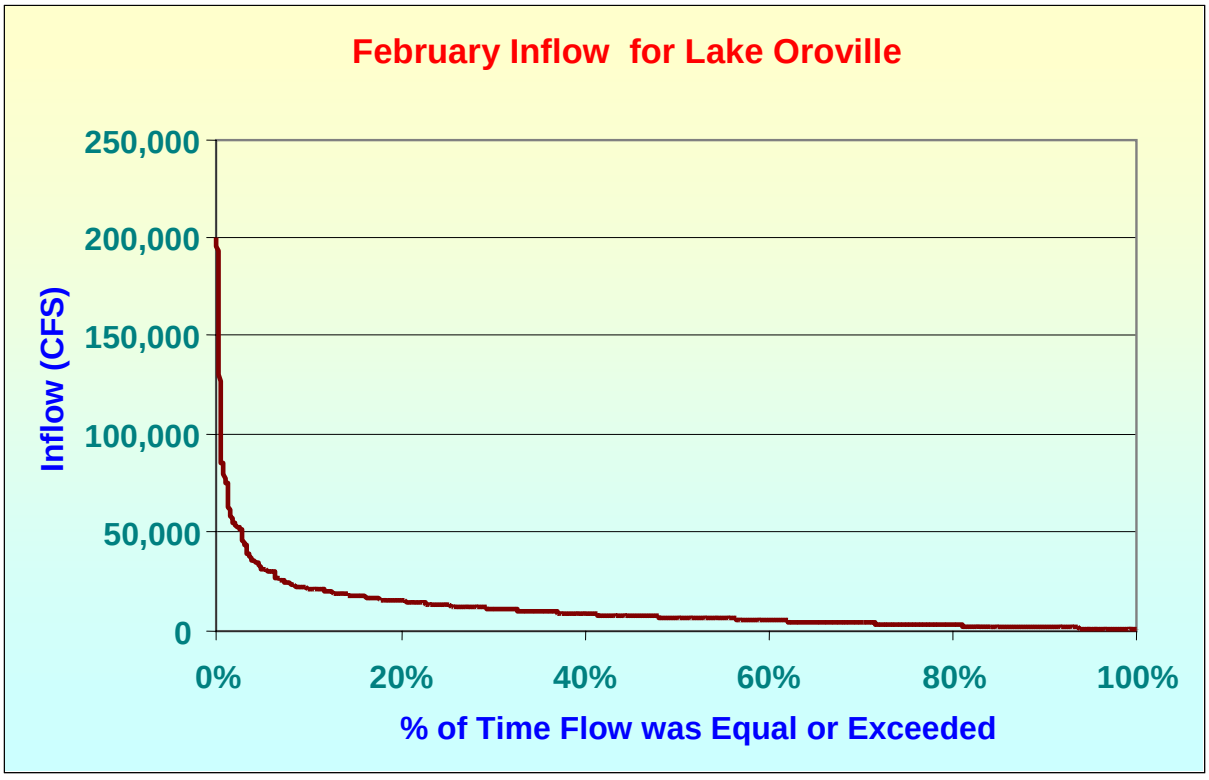
No major upgrades are proposed for the Oroville Facilities, although it is anticipated that the pump units or turbines may be replaced at Thermalito Diversion Dam Powerplant or Thermalito Pumping-Generating Plant. On going maintenance will include minor upgrades as necessary to maintain the facilities.

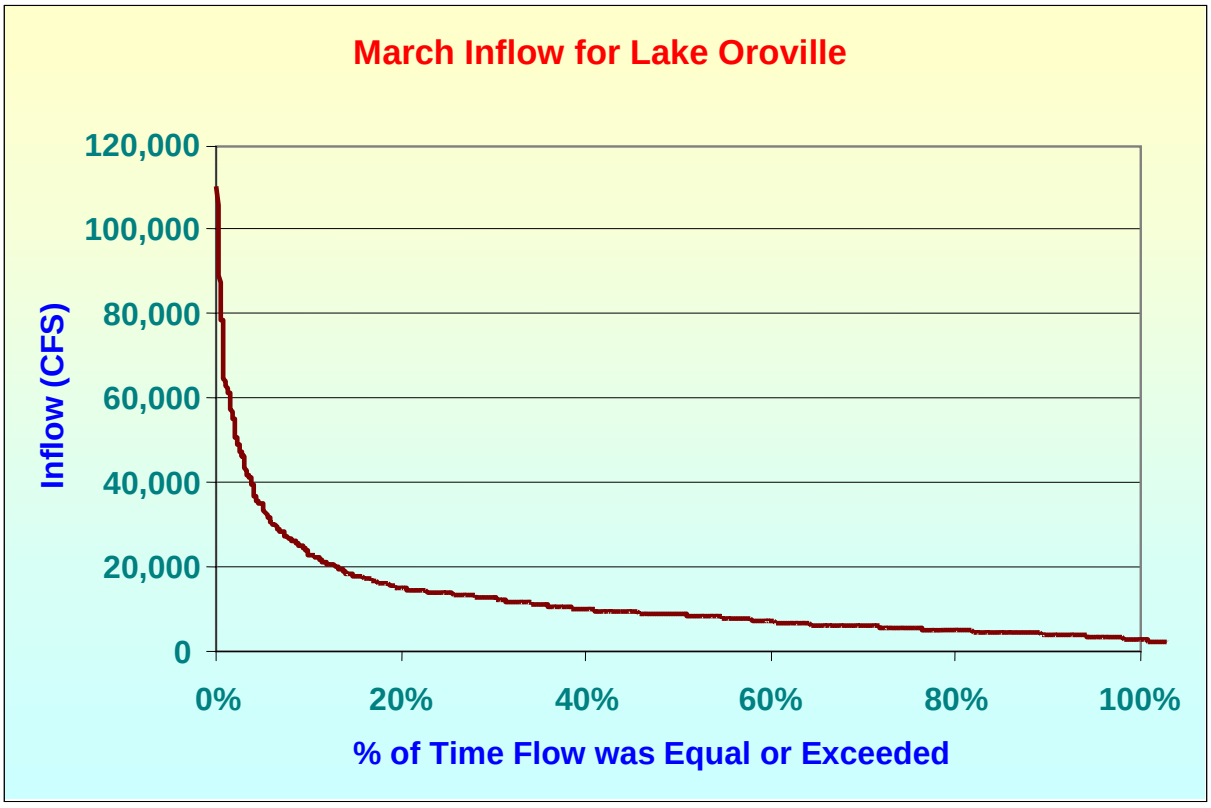
APPENDIX A
ANNUAL AND MONTHLY FLOW VERSUS DURATION FOR INFLOW OF LAKE OROVILLE

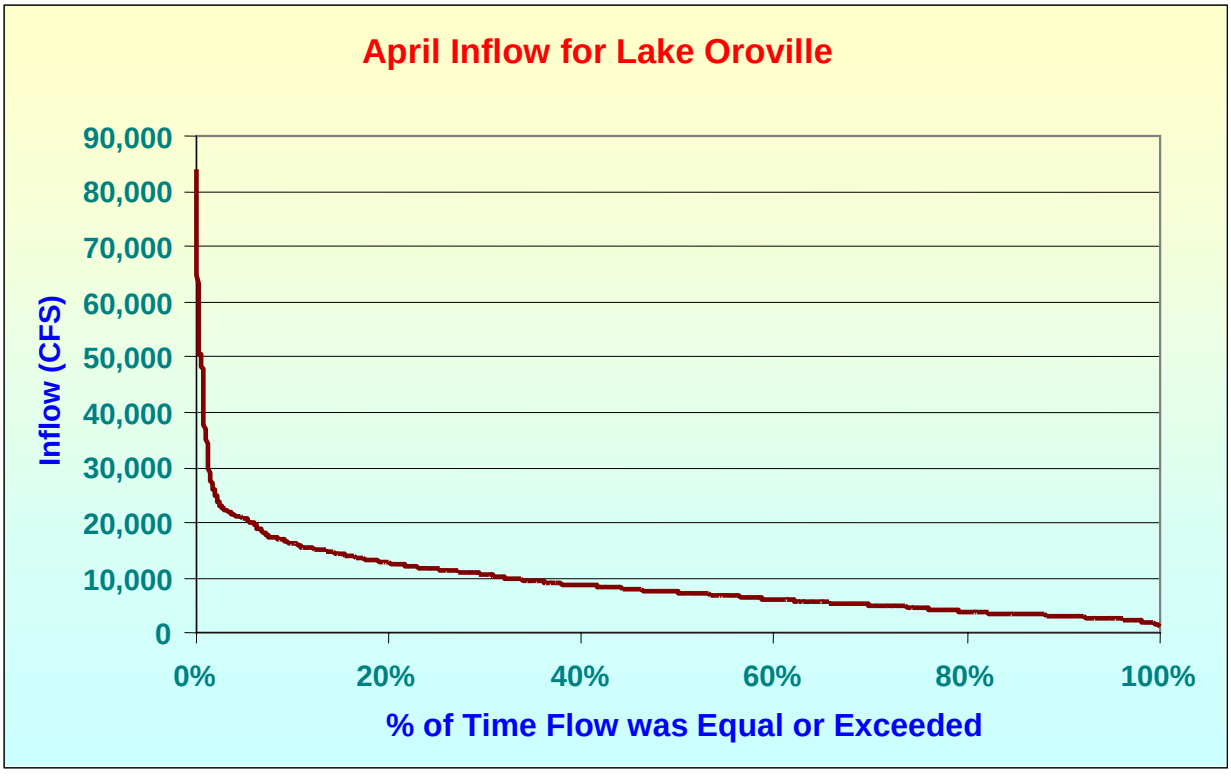


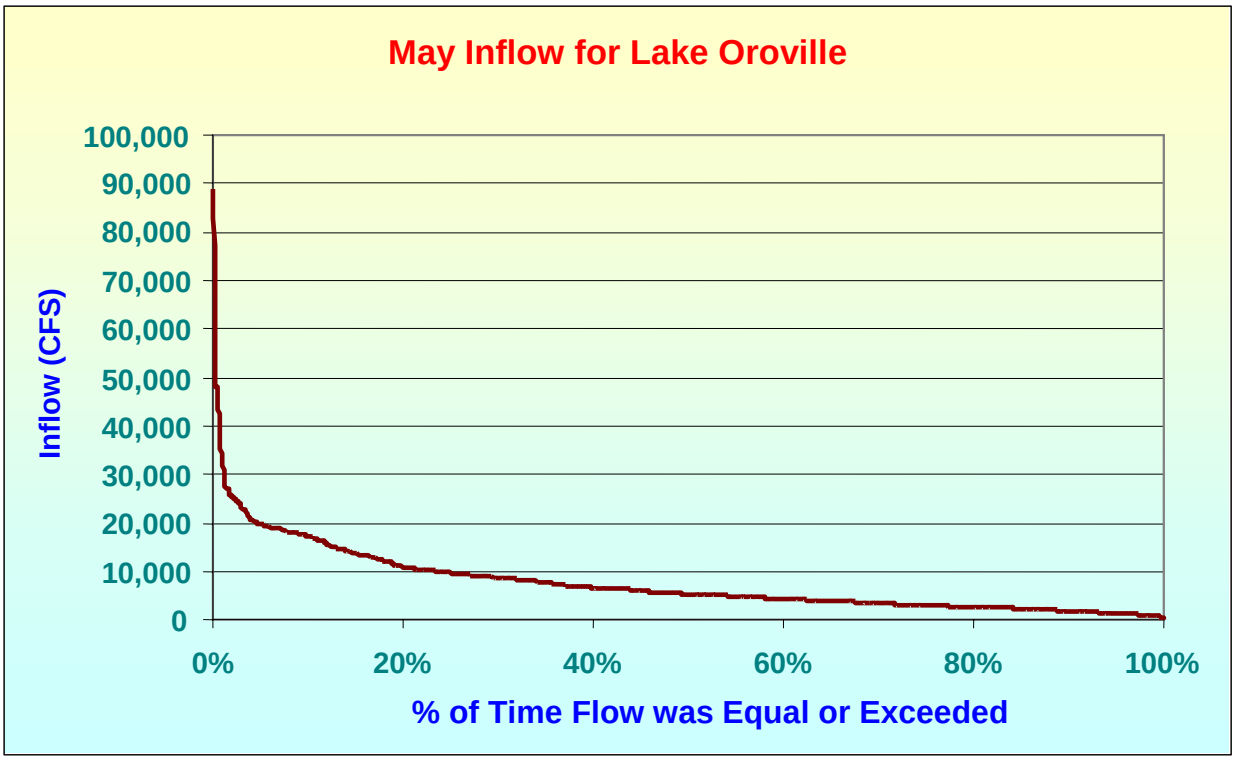
Source: DWR 2004. Inflows based on daily data from 1979 to 2001

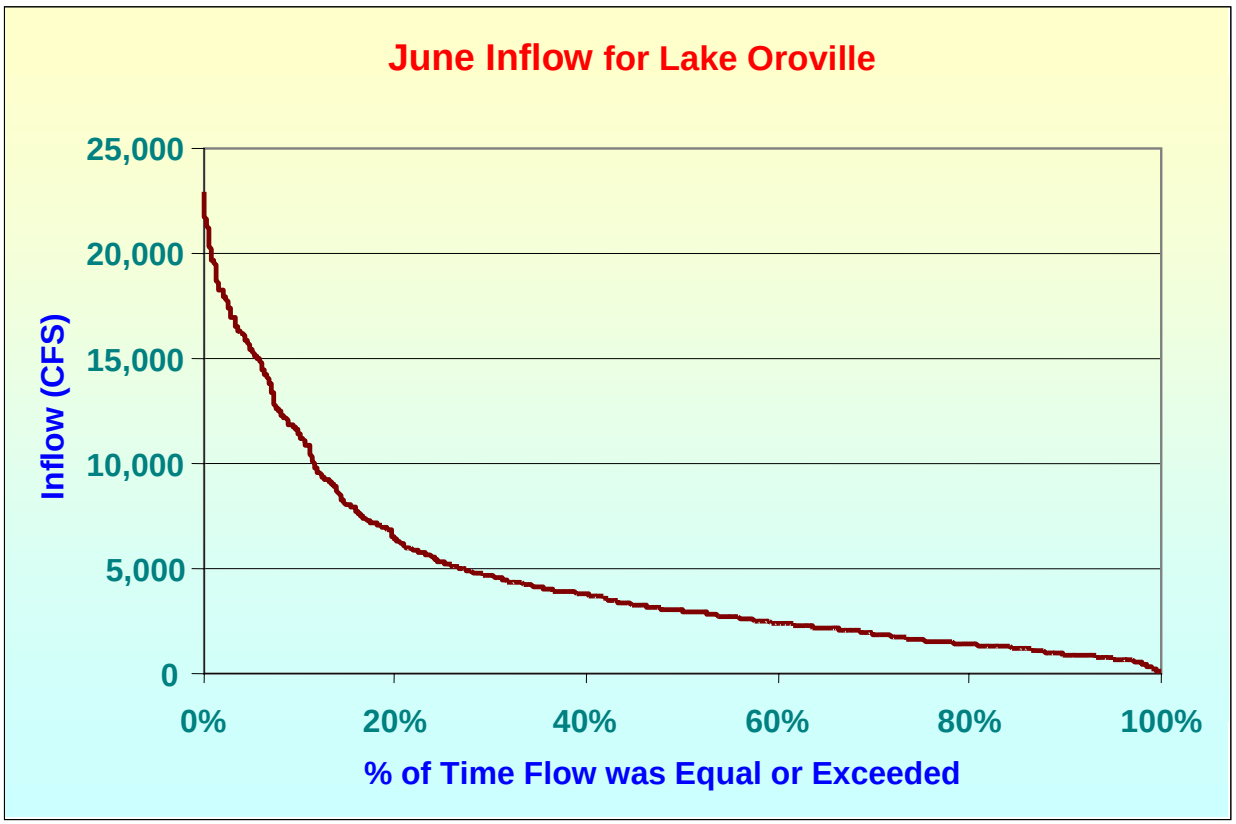

January Inflow for Lake Oroville
300,000
250,000
200,000
150,000
100,000
50,000
0
Inflow (CFS)
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

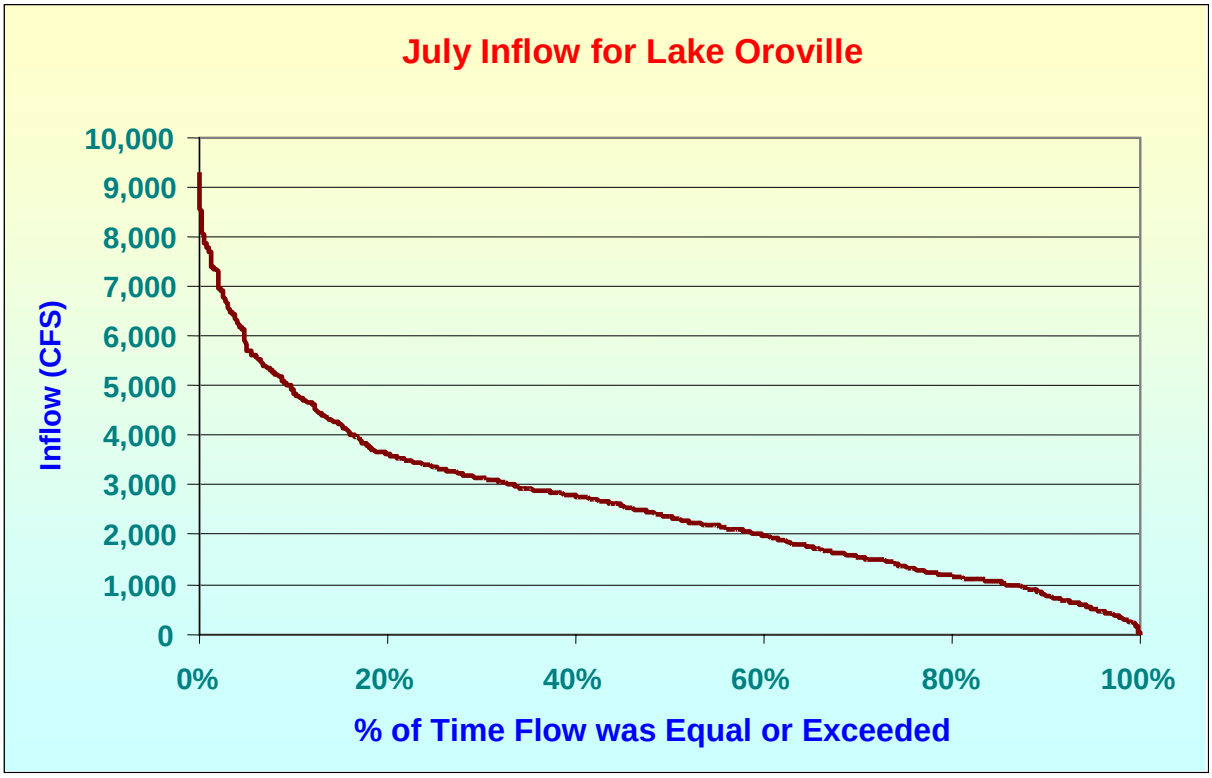

February Inflow for Lake Oroville
250,000
200,000
150,000
100,000
50,000
0
Inflow (CFS)
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

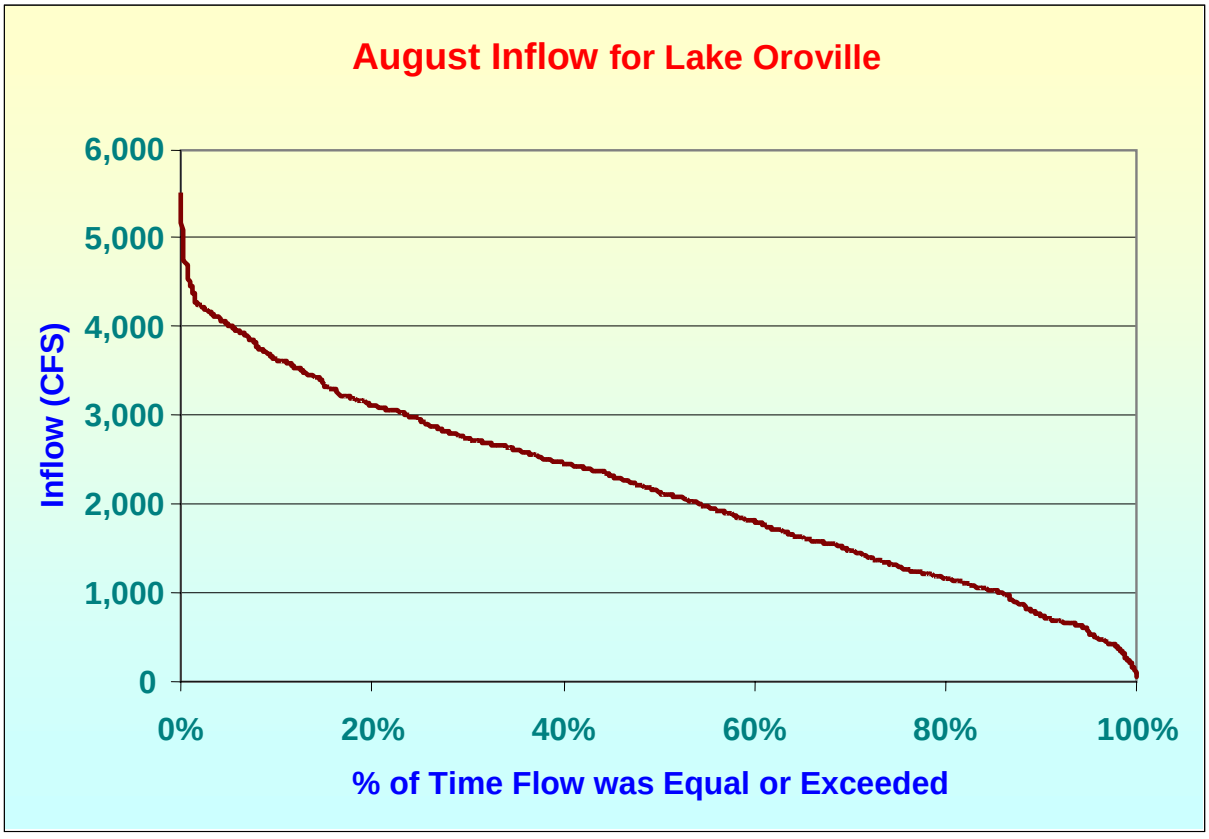

March Inflow for Lake Oroville
120,000
100,000
80,000
60,000
40,000
20,000
0
Inflow (CFS)
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

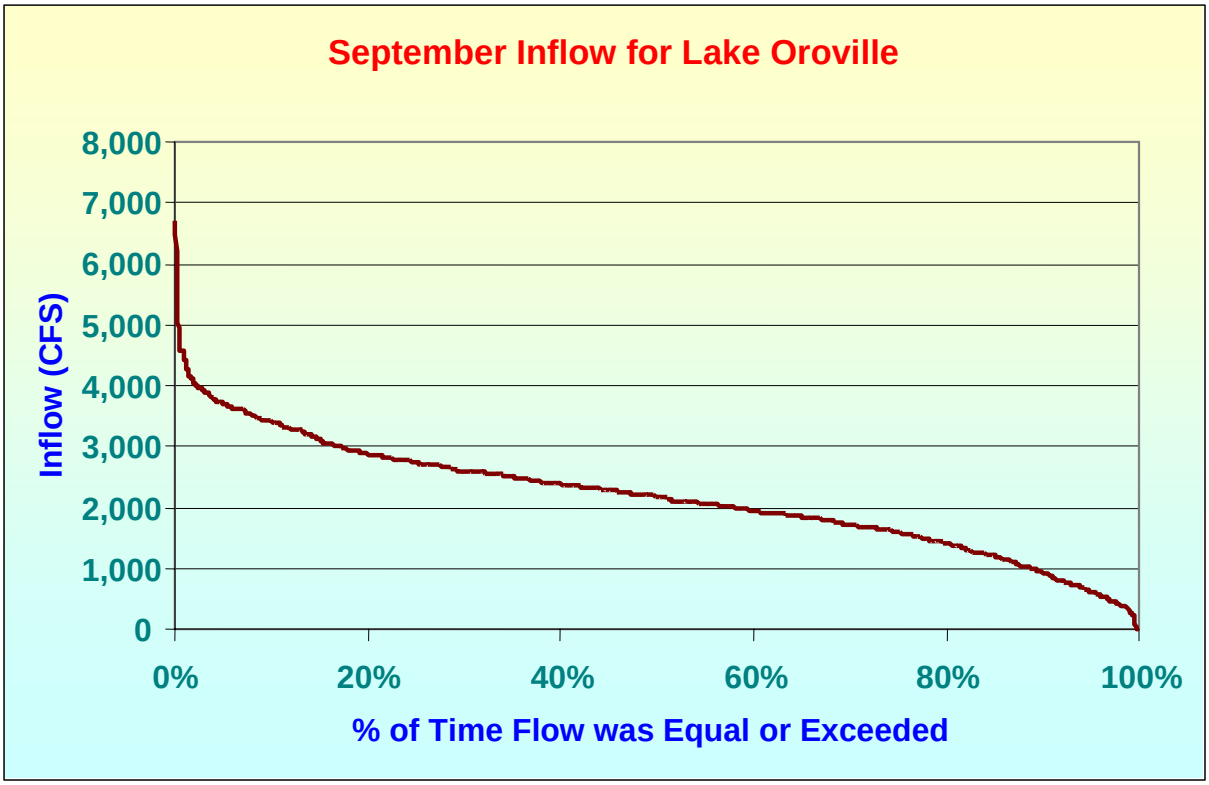

April Inflow for Lake Oroville
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Inflow (CFS)
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

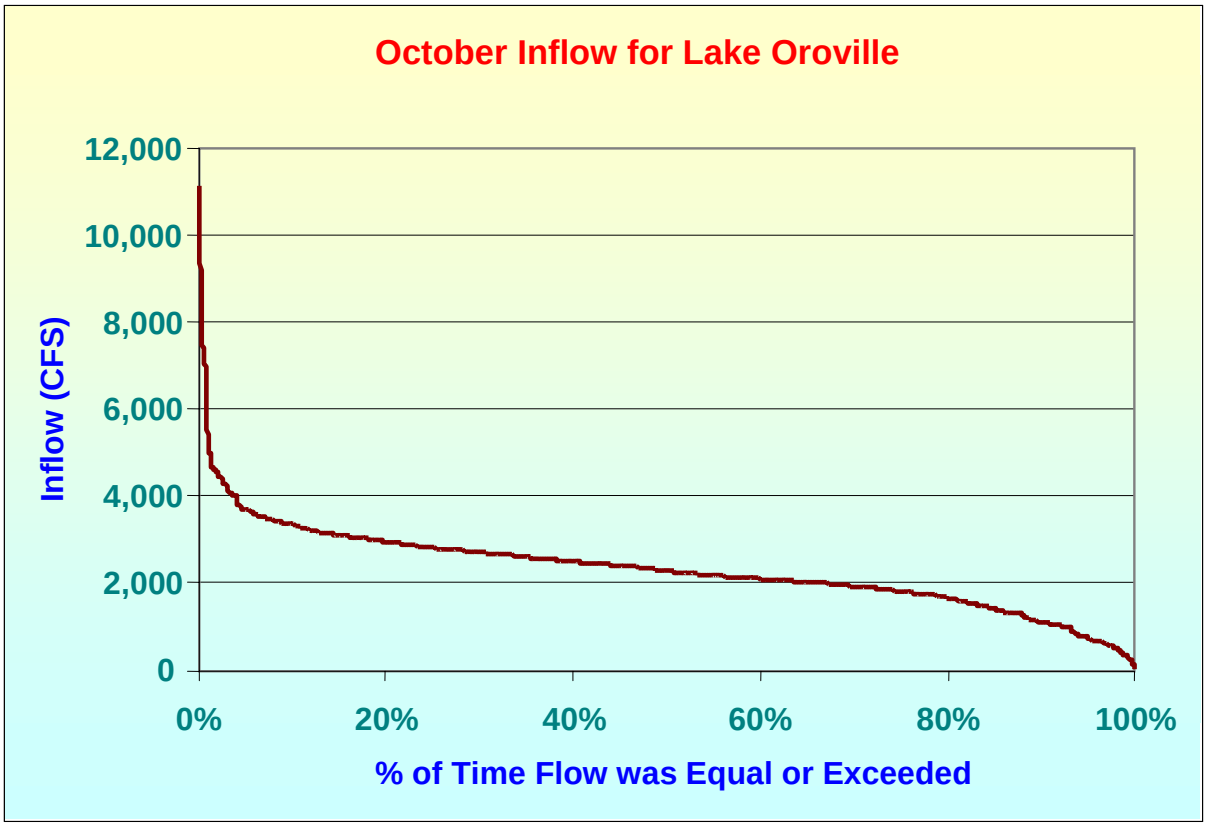

May Inflow for Lake Oroville
Inflow (CFS)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

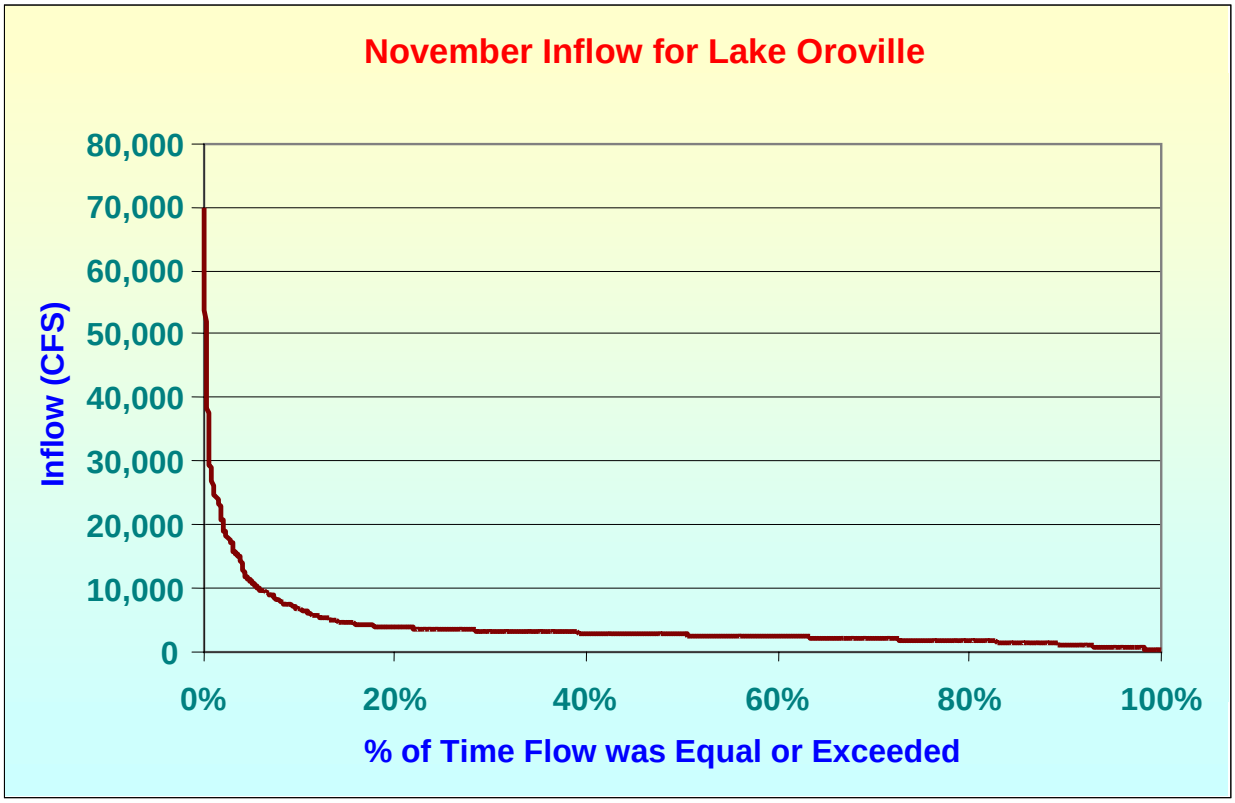

June Inflow for Lake Oroville
Inflow (CFS)
25,000
20,000
15,000
10,000
5,000
0
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

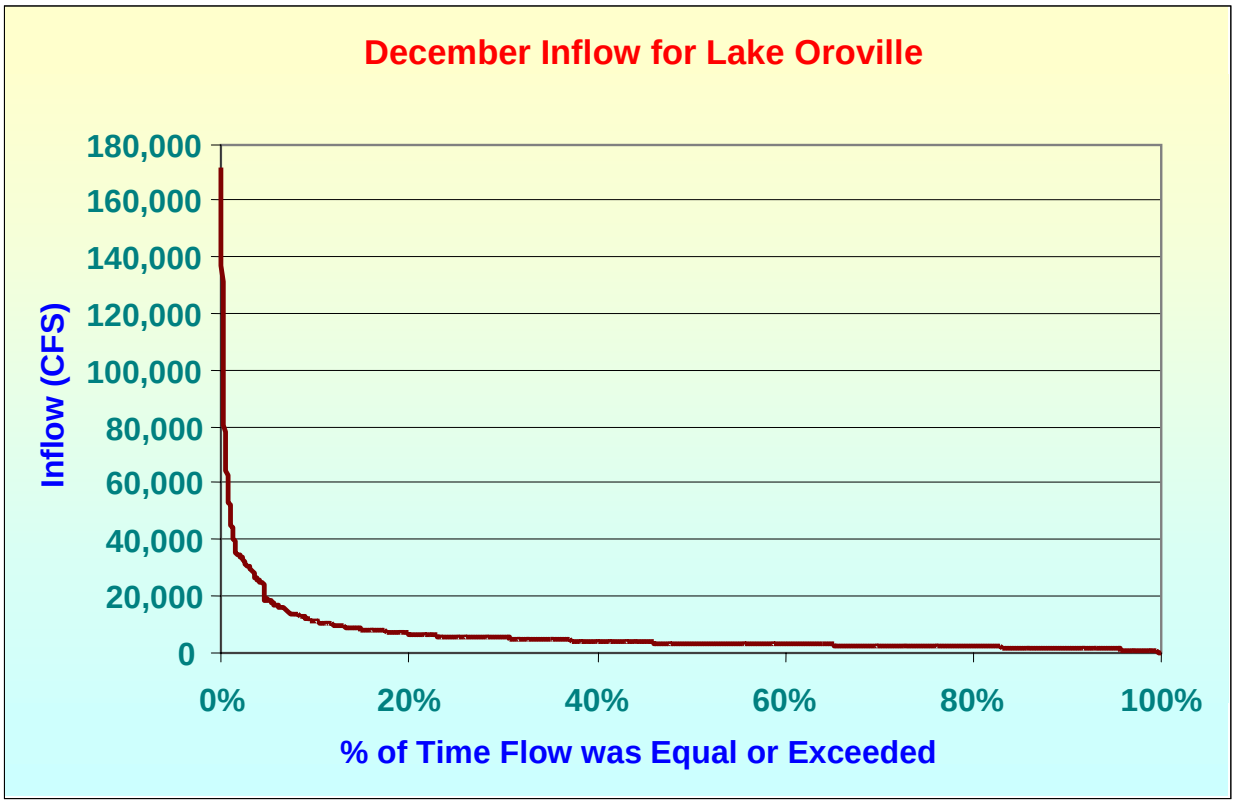

July Inflow for Lake Oroville
Inflow (CFS)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded


August Inflow for Lake Oroville
Inflow (CFS)
6,000
5,000
4,000
3,000
2,000
1,000
0
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded


September Inflow for Lake Oroville
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Inflow (CFS)
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded


October Inflow for Lake Oroville
12,000
10,000
8,000
6,000
4,000
2,000
0
Inflow (CFS)
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded


November Inflow for Lake Oroville
Inflow (CFS)
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded


December Inflow for Lake Oroville
Inflow (CFS)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0%
20%
40%
60%
80%
100%
% of Time Flow was Equal or Exceeded

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